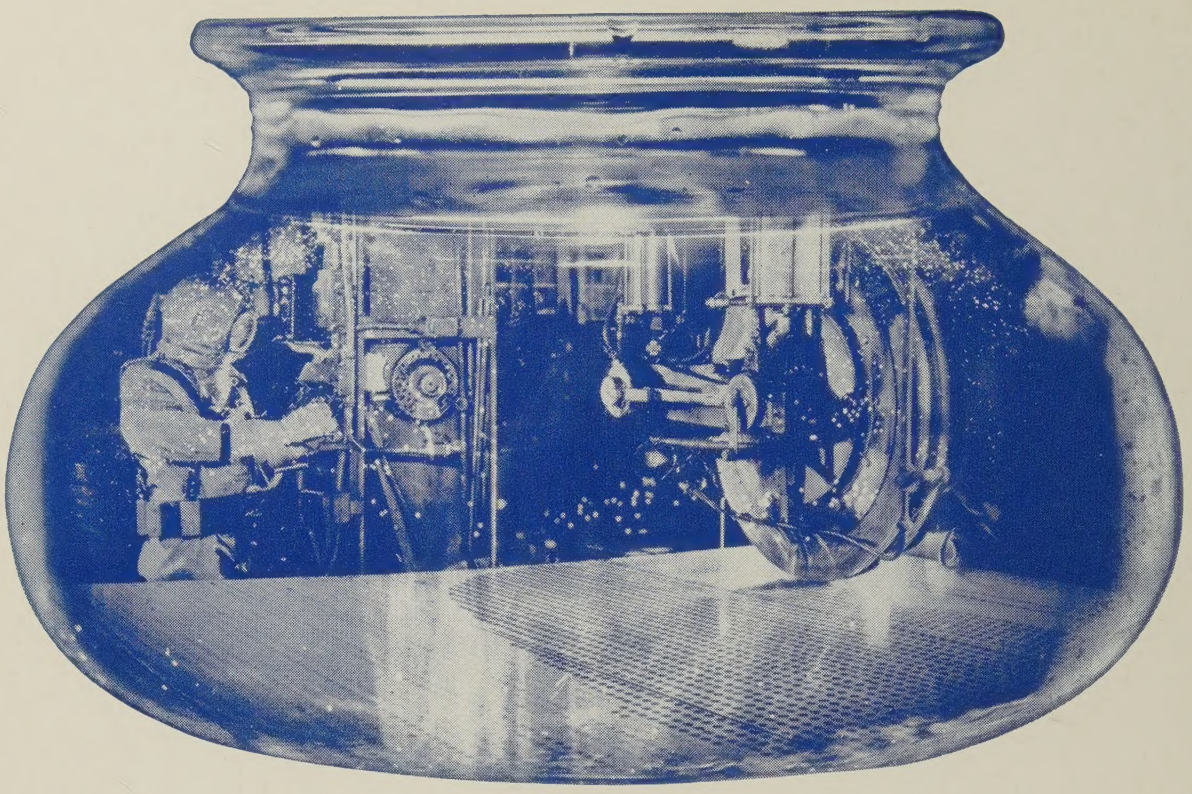
Tappi

PUBLISHED BY THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY

FEBRUARY 1952



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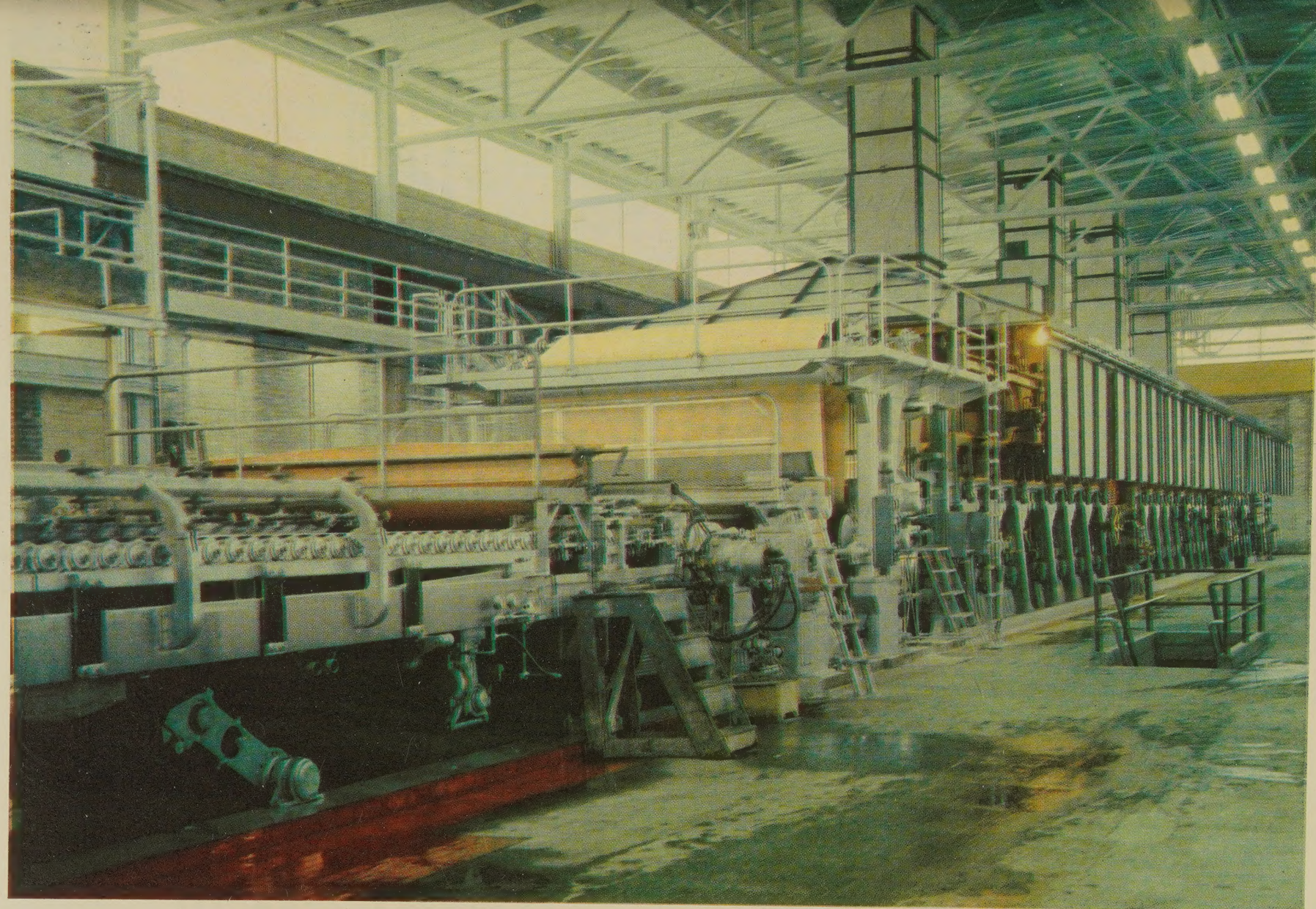

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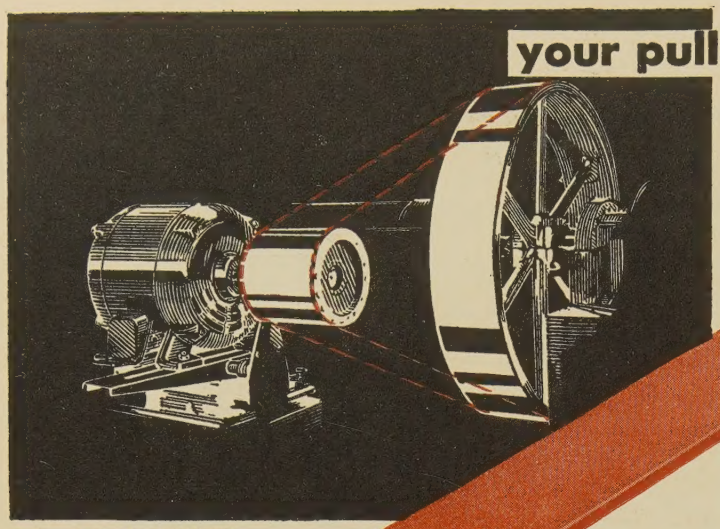

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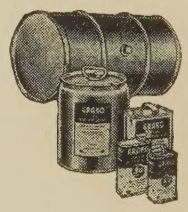

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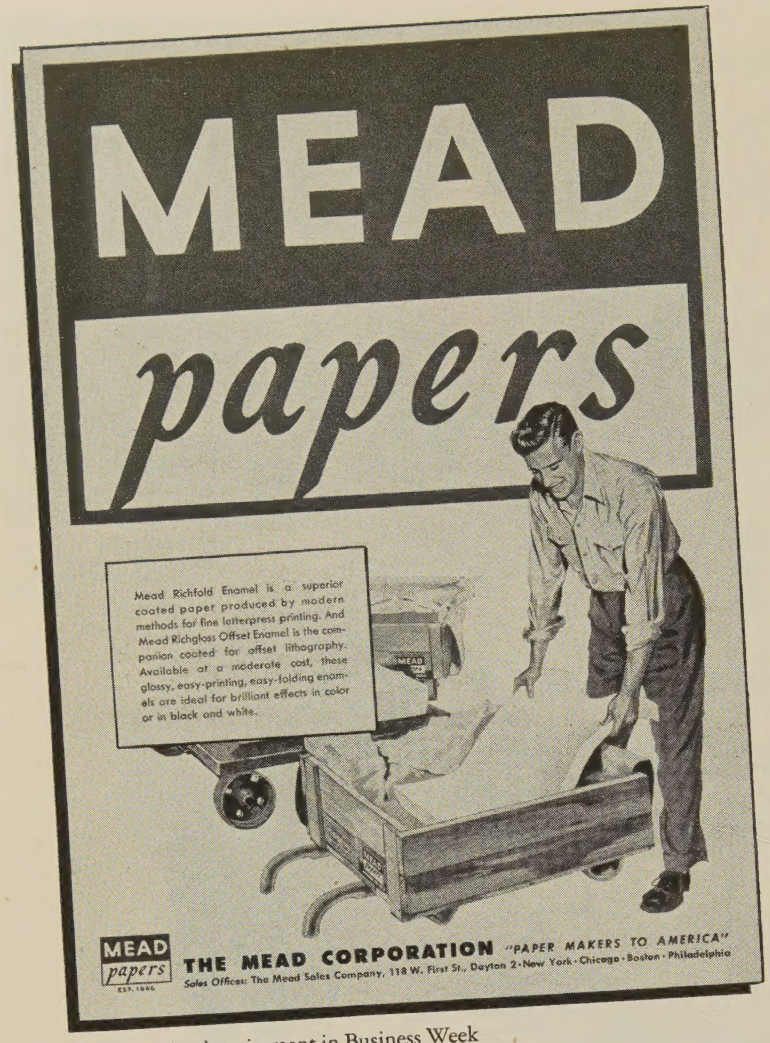
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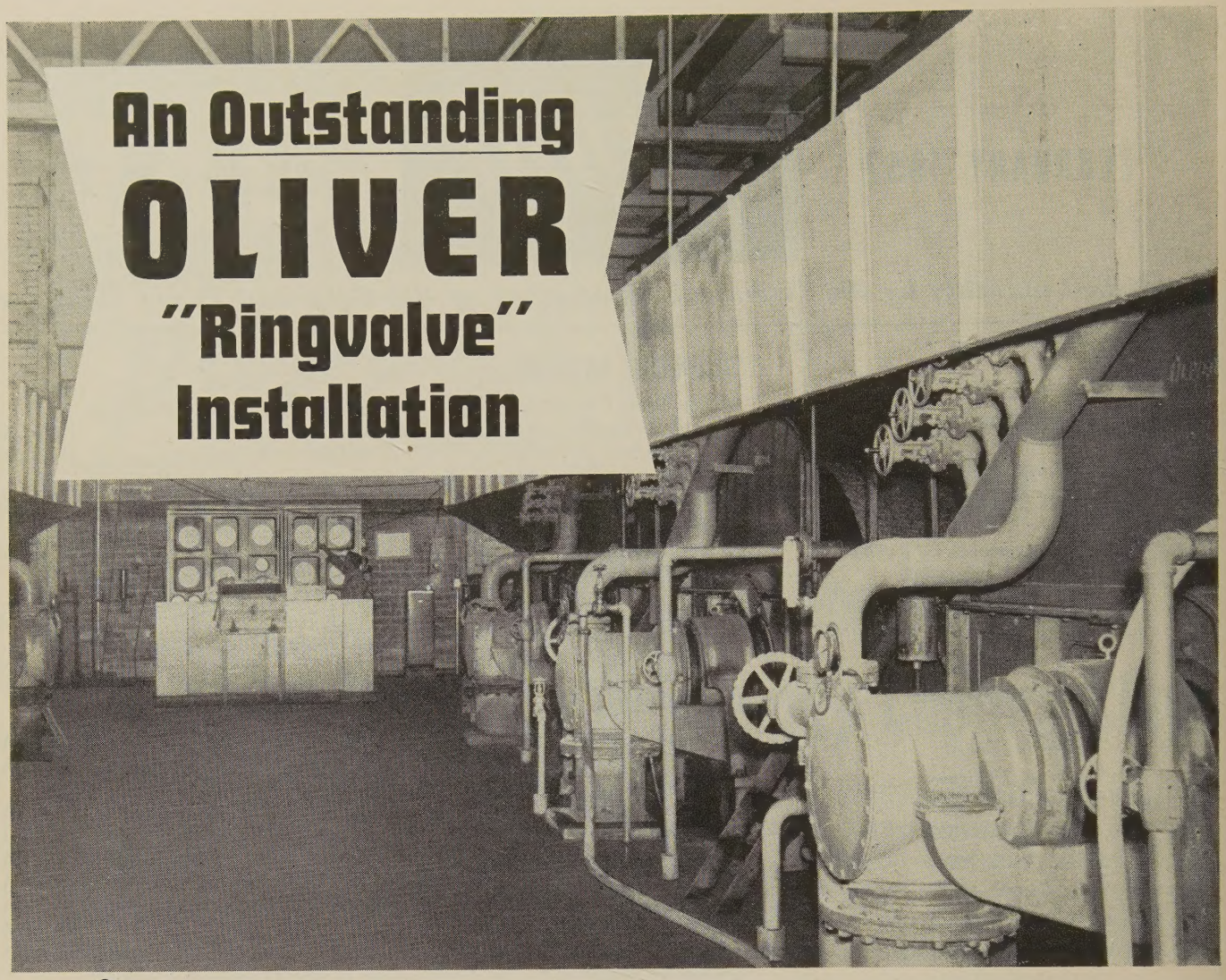

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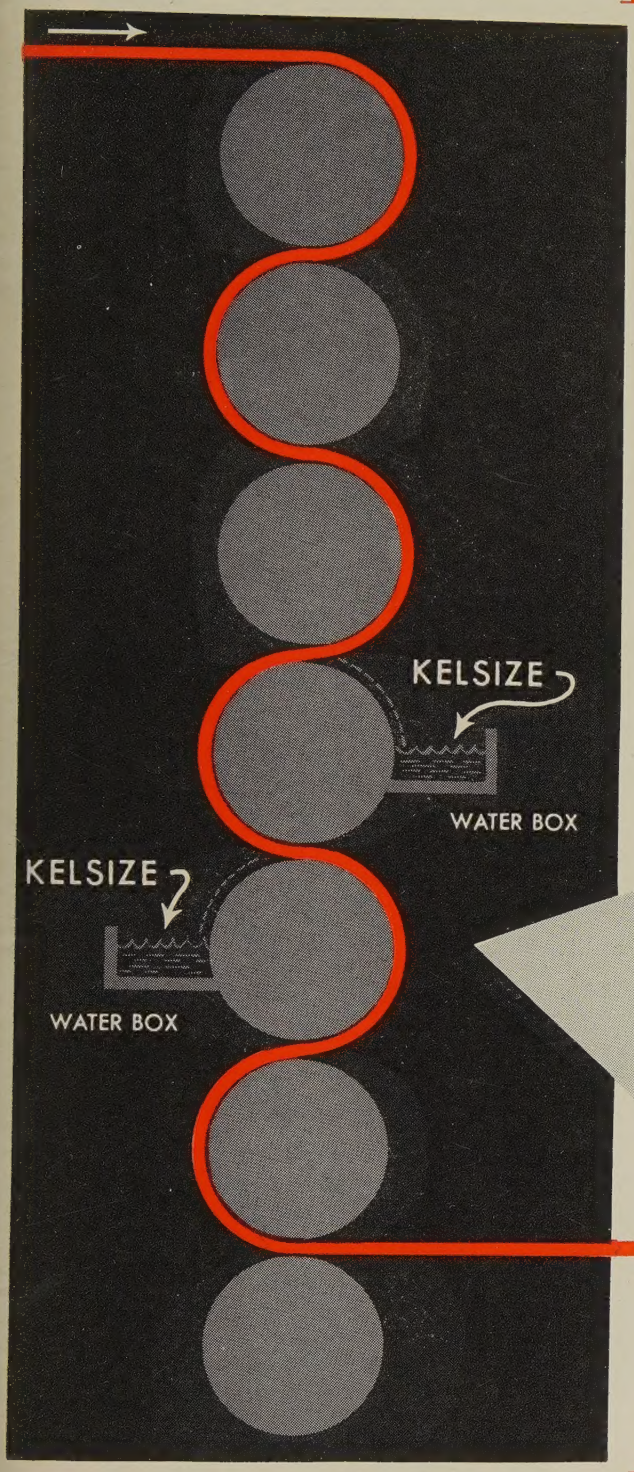

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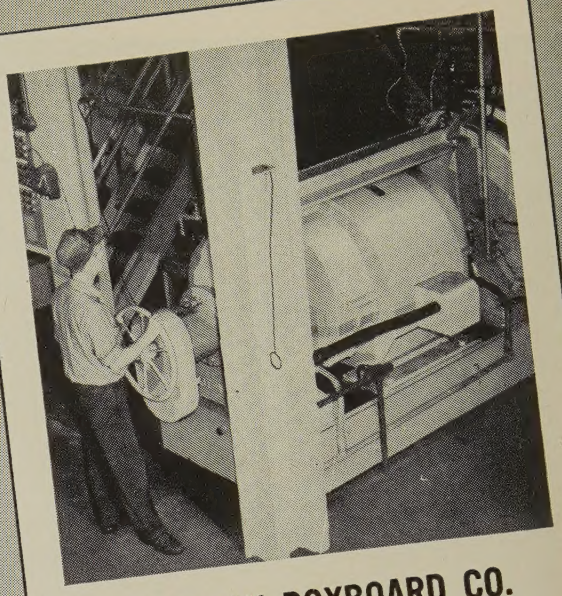

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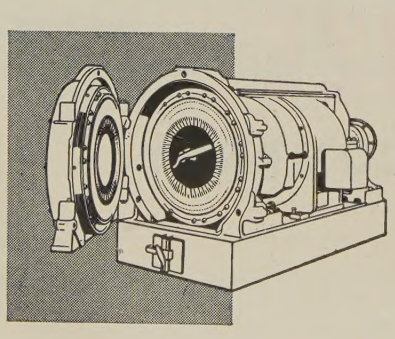

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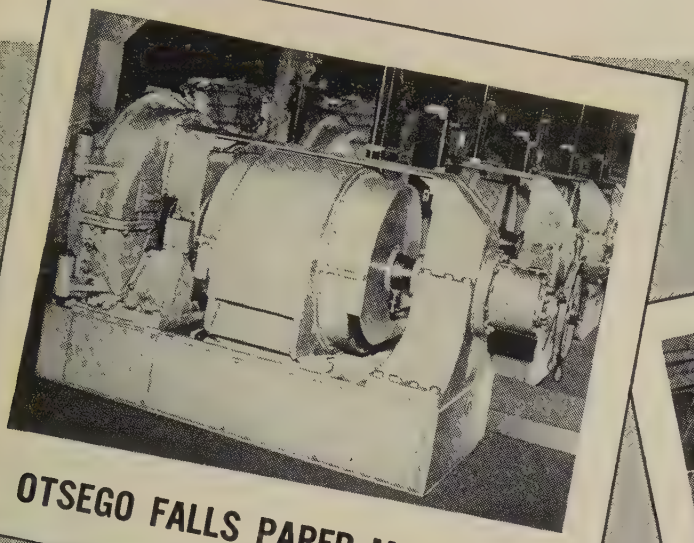

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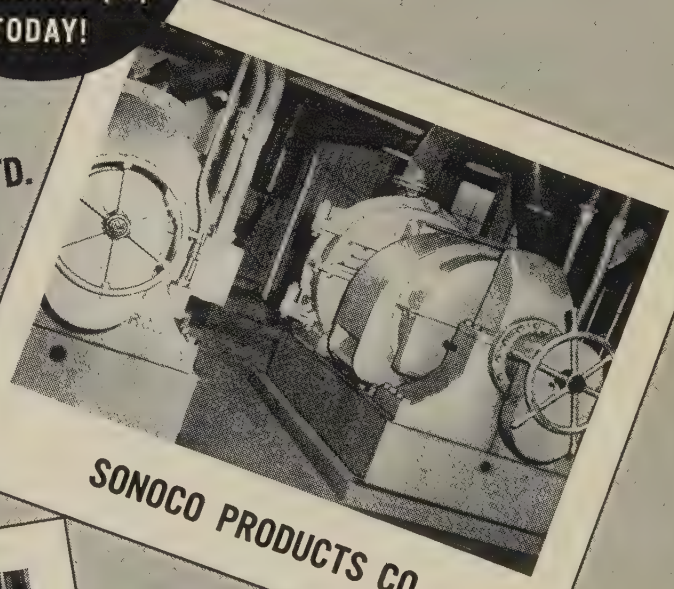

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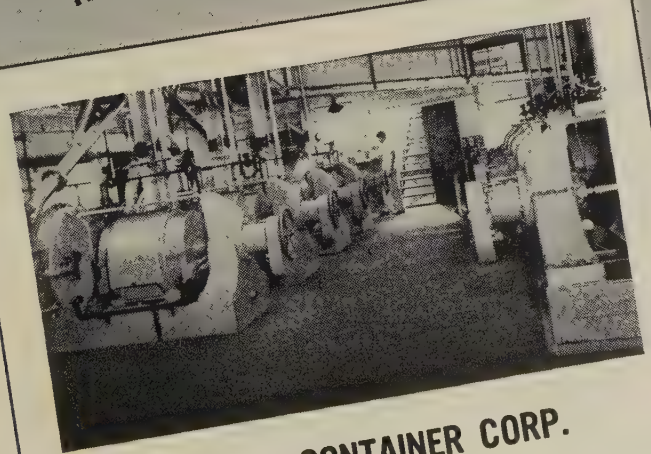

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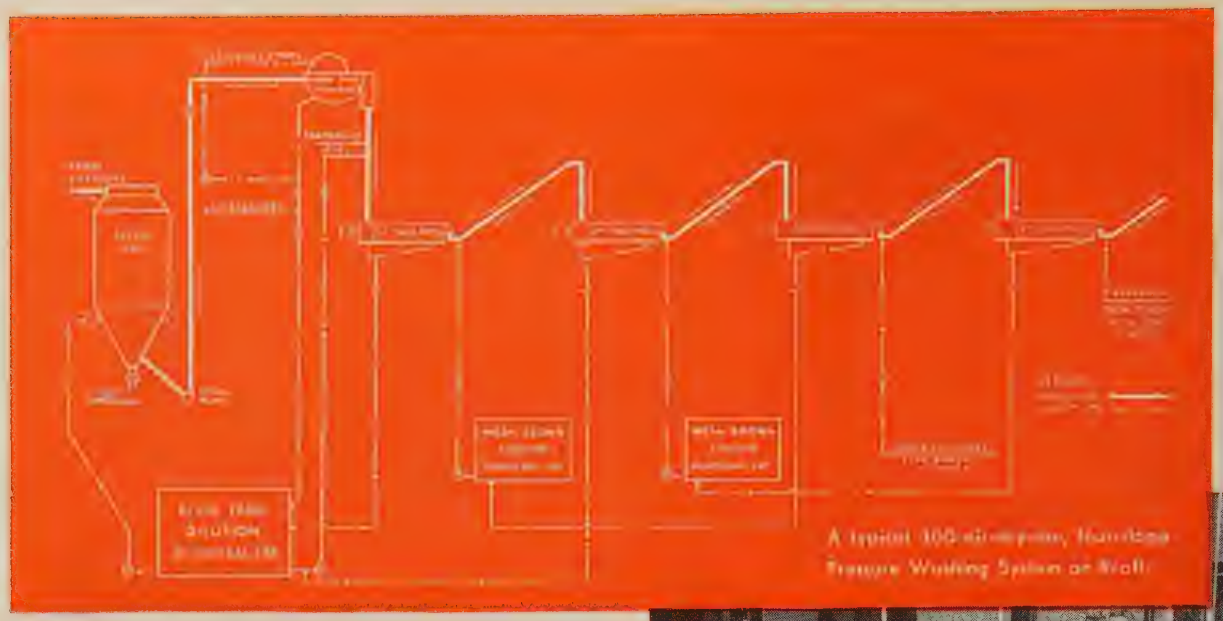

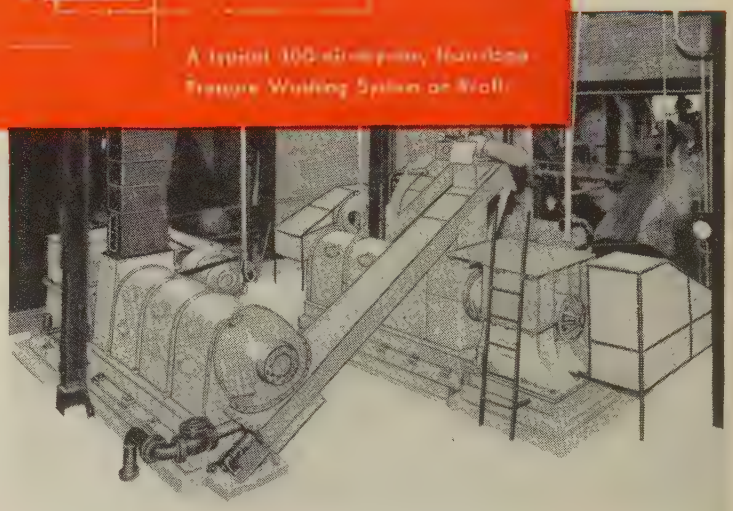

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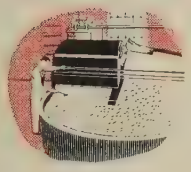

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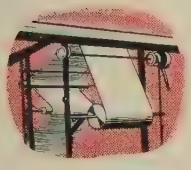

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The New Challenge

A. E. H. FAIR

A. E. H. Fair

For longer than most of us can remember, the name "Kalamazoo" has been synonymous with papermaking. In the old days if a papermaker hadn't at some stage in his career worked at Kalamazoo, he just wasn't a papermaker. Kalamazoo is still second to no other city as a papermaking center. It is, therefore, a real honor for a Canadian to be invited to come to Kalamazoo, and particularly to address a joint meeting of TAPPI and the Superintendents' Association.

It is not easy to choose a subject for a gathering such as this. To talk of papermaking, or to attempt to deal with technical subjects in Kalamazoo with this audience, would certainly be carrying coals to Newcastle.

There is one subject which interests technical men and operators equally. It also interests both management and executives. This subject is the prevailing shortage of trained personnel. It is actually an old problem, but it has important new aspects. It has, in fact, grown to such magnitude now that it has become a challenge to all of us.

Early in December, Colonel Urwick, Vice-Chairman of the British Institute of Management, addressing a meeting in Montreal, stated that management and administration today is exercised largely by people who have no special training for their responsibilities. And the community, particularly in Great Britain, appears satisfied that it should be so. After enlarging upon his subject, he concluded with this statement: "If this is democracy's last word on this subject, it will, I am convinced, be for many centuries to come, democracy's last word on any subject."

While these views appear to be extreme, and I think they are exaggerated, insofar as our industry is concerned, they are nevertheless based on fact, and this fact is general. It is not restricted to any country or any industry. The condition exists in varying degrees everywhere.

About twelve years ago I overheard a conversation in a pullman smoker. One business man was expressing serious concern over the fact that his firm was suffering from a shortage of trained personnel. He couldn't quite understand why. Two of his friends who were present, had the same problem, and they did not see any early solution. Finally we all found ourselves in a discussion which led back to the first World War with its diversion of young men from industry, and the losses of life that depleted young man power. The war, it was agreed, had interfered with the development of personnel for industry. This, in addition to casualties, had the effect of losing a generation. After the war came the depression when throughout industry personnel was reduced to a minimum. Industry simply couldn't afford to carry any extras. Then came the period of improved business when unions were strongly organized. Seniority clauses were introduced into agreements, and efforts were made to exercise seniority even to the detriment of recognizing ability. Every man who had a good job froze to it. The drifting of employees from one plant to another stopped.

Gradual improvement in business was accompanied by permanent economies and better efficiency. More efficient equipment brought specialization, and this further narrowed the scope of the individual. Faster machinery made training more essential. The skill factor rose. Rates of pay increased. Higher labor rates increased costs. This multiplied the weight of responsibility of skilled jobs. Each of these steps formed a link in the chain to bind the individual, narrowing his field and restricting his opportunities for training. These restrictions affected not only the skilled worker, but the technical man in industry, who must be one of the potential sources of senior management material. The technical man must have practical training to be an effective member of the management team. But the door had been gradually closed to all personnel who required training, and opportunities for experience were disappearing.

We finally agreed that management had learned a lesson, that sound policies must evolve to overcome the threat to the future of business. Everyone had learned that without trained men business could not hope in the long run to benefit from its technical advances.

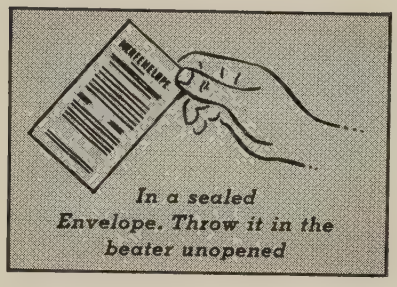
But World War II came, and it was longer than World War I. The man power demand was much greater than ever before. Somehow industry managed to get by with the help of old-timers who came back and did their best. They, along with female help, managed to fill the gap. Again the opportunity to strengthen the skilled forces in industry had gone for a period of nearly six years. In the postwar expansion the shortage became even more apparent, but in the rush to produce there was little opportunity to do more than take care of the increasing demands for more help.

Early this year the pullman incident was repeated. This time a new group of men were troubled with the old problem. All except one of the group were worried, but this one expressed confidence in the training pro-

A. E. H. Fair, President, Alliance Paper Mills, Ltd., Merritton, Ont.

Merfenelopes

FOR SLIME CONTROL



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Reduces Washups
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gram of his company. He praised its effectiveness and its scope. He explained that the program covered the full range of staff, including management. He promised to send us a complete description, and did so a little later. It was very impressive. This time the conversation ended with agreement that before very long industry would be realistic enough to develop training procedures which would ensure an adequate supply of skilled operators thereby insuring its own future.

Some of us were surprised about three months later to learn that our friend with the training program had been promoted, and that a successor was brought in from outside. This, of course, is happening all the time, maybe not to the same degree as in the past, but the practice is nevertheless still prevalent. It may be argued that hiring outsiders for key jobs cannot be avoided, and it is desirable from many points of view. Maybe this is so, but if we want to preserve morale in our own organization we should go out of our way to promote from within. If we have lack of confidence in our local staff we can only assume that we must have some square plugs in round holes, or that we have not, for some reason, been able to provide the training that they need for promotion. In any event, as pension and similar plans become more prevalent, it is going to be more difficult to hire skilled men away from organizations who have had either the foresight or the good fortune to be overstaffed with skilled operators.

When your committee asked me to address this gathering, and explained that the attendance would cover a wide range of interest in the field of operating, technical, and management personnel, the subject of employee training appealed to me as one which should at least be timely. But before deciding finally, I called some friends who represent a cross section of our industry. Everyone without hesitation picked this problem as his most serious. The answers were not identical, but it was evident that the thinking was essentially the same.

Now we again find ourselves facing war and preparation for war. The shortage of trained help is still with us and will probably be getting worse. We have still more reason to be concerned about the future, because somewhere in most organizations there are weaknesses which before long may break wide open and leave serious gaps. Again the quick decisions will be forced which, influenced by emergency, may have serious results. Why does this condition continue? Some reasons have already been given, but we should not be contented with knowing the reasons. We should attempt to find an antidote. In other words, if we are going to produce more paper we will have to produce more papermakers.

The paper industry has undoubtedly gone through a major transition in the last quarter century. This transition is of greater magnitude than we sometimes realize. The change has not been complete, nor has it been balanced. It has occurred to a greater degree in some parts of the industry than others. It has been unbalanced in that personnel policies have, in the great majority of cases, not kept pace with the advances in operating methods.

It is obvious that we can no longer take a chance on hiring a man who is simply looking for a job. Papermaking is a skilled vocation. There is little room for anyone who is not at least potentially a department head. A basic standard of education is essential in the pulp and paper industry. Employee selection by psychological and aptitude tests has merit, but the old standby of good judgment must still take precedence over everything else. Where the personnel department screens the men beforehand, this should not relieve the superintendent or manager of the responsibility of putting the right man on the right job.

And when the man gets on the job he should be treated intelligently. He must be afforded the training which will permit him to make reasonable progress. He should have a goal which, with interest and effort, can be attained within a reasonable time. This is the problem of management. But management needs assistance.

When we read of the many millions that are being poured into the expansion of the pulp and paper industry, we are to put it mildly, very much impressed. We are also impressed by the many technical advances which have brought better control of raw materials, pulping, and papermaking. Undoubtedly newer mills and improved methods have been responsible for lower costs and better quality. By mechanising and introducing automatic control, labor has been reduced to the point where we now have more than one paradox.

It is a peculiar fact that where closer control has been established, the frequency of pulp and papermaking problems has been reduced to the point where experience has become much more difficult to obtain. We know that a man can learn only by doing. To find his way out of difficulty he must first get into it, and maybe more than once. Watching the other fellow do a job is a very poor substitute for doing it ourselves. When a G.I. learns to shoot he aims the rifle and pulls the trigger. The instructor doesn't do it for him.

The further we carry our programs of control, the closer we come to mechanical perfection, the less frequent should be the chances of learning how to get out of difficulty when it does occur. The more we specialize, the more the situation will be further accentuated, and to make matters worse the hourly costs keep mounting. Lost time and repairs cost more and more. More than ever repairs and lost time must be kept at a minimum. More than ever skill is required to do this.

There is a second paradox. It comes from the development of more complete employee welfare plans. Unfortunately, a high percentage of our people work to live. Few live to work. Security is too frequently the principle incentive behind human endeavor. No one can deny the fact that security for the conscientious workman is a fine thing. It should improve his efficiency, and everyone should benefit. Few of us would question the merit of sickness and accident benefits, pensions, and unemployment insurance. But are we buying security too dearly? Is it not possible that in the long run our society might benefit more with less security for the individual, and more for industry, which is after all his source of income and therefore his real security. With rising break-even points through more fixed costs the average industry today has reason for concern.

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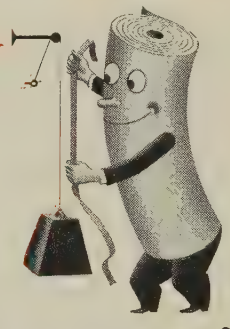

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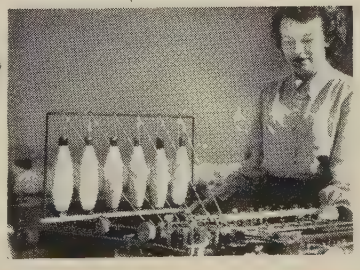

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Too much security can breed complacency. The very life blood of free enterprise is willing endeavor. In spite of all the contrary influences management must by some manner or means develop enthusiasm. This is relatively easy to do with the man who is naturally enthusiastic. The great majority of papermakers and technical men who have achieved success have placed the thrill of accomplishment ahead of monetary return. No one should be criticized for wanting to earn a good living, or for expecting reasonable security, but it is the urge to do that forms the foundation of success. Unfortunately there are too few who have this urge. It is too bad that there are not more. They are the prospects for the future, but there are certainly not enough of them and there never will be. We therefore must strive to develop the less zealous, and it is evident that this is a big assignment.

To begin at the beginning, namely, in the individual mill or company, no training plan should be considered complete unless it embodies, with the active support of management, a program of familiarizing all key men with the background and policies of the company. The most loyal employee and the most efficient man is the one who is best informed. Any responsible individual who works for a firm should know his company's products and their end uses. He should have an opportunity to see the customers' plants. He should learn to appreciate the importance of good will. He should even have a knowledge of costs and their relation to his job. In other words, to use the old phrase, he must belong.

If thorough, properly organized employee training plans within the individual companies could provide sufficient training in the time available, that would be a fine thing. But as pointed out before, the seniority restrictions, the narrowing of the scope of the individual, and the general reduction of opportunity to be trained, make this a general problem of the whole industry, rather than something which can normally be handled effectively by the individual company. Furthermore, many do not even have a training program nor do they apparently intend to do much about it. It is easier to let the other fellow do it, and it may appear to cost less that way. But it doesn't. It costs everybody more. Furthermore, it is always a big gamble to hire an outsider, with little real knowledge of his capabilities. Many times it would be less costly to promote a man, even though he does not have the training.

The inadequacy of training within industry has to some extent been alleviated by the fact that more university educated men have joined the operating staffs within the last quarter century. Some of these men have had the benefit of valuable training during their college courses. Some of this training has been on a semicommercial scale. More than one university in the United States and one in Canada have valuable facilities for this purpose. The industry has benefited and continues to benefit from the fine work that has been done by these institutions, but this does not cover the field of general training for operating personnel. The staff of a mill consists largely of men who have no university background. They are not prepared to step aside without question to surrender their seniority to the technically trained man, even though they realize that he already has a type of knowledge which they lack. Therefore, the technical man, if he wishes to be a properly trained operator, also becomes involved in the training program.

Just as the practical man and the technician have learned to work closely together in the mill, so have TAPPI and the Superintendents' Association grown closer in their interests and their activities. They have realized that they have much in common. One who is a member of both organizations cannot help but recognize the merging of their interests and the broadening of their views. This broadening of aspect cannot help but be beneficial to everyone.

I would like to suggest that the time has now come when the development in scope of these two associations should bring them into the personnel field. This suggestion is made knowing that their policies have in the past been to concentrate principally on materials and methods leaving men to be dealt with within the individual companies or through other groups. To intimate that these policies be changed might be assuming too much. But one cannot help but feel that organizations, so representative of the industry, and so directly involved in a problem such as employee training, might logically take a more direct interest in it. It is, after all, their membership who make up the skilled personnel of the industry. It is their future membership who stand to gain or lose the most. It would seem feasible, therefore, that there be within both of these organizations committees for the development of employee training. At first, the scope of these committees might be very limited, and might be restricted to exchange of ideas. Eventually the field should widen, and if sympathetic support is provided by management, accomplishments commensurate with those already evident in other fields might be forthcoming.

The majority of executives in our industry either are now, or have been, members of TAPPI or the Superintendents' Association. They appreciate the accomplishments of the past, and the scope that lies in this new field.

It is difficult to be specific in enlarging upon this subject. It is probably impossible to be original. One suggestion would be that the committee sponsor intermill exchange where feasible. This might involve complications but would not be impossible.

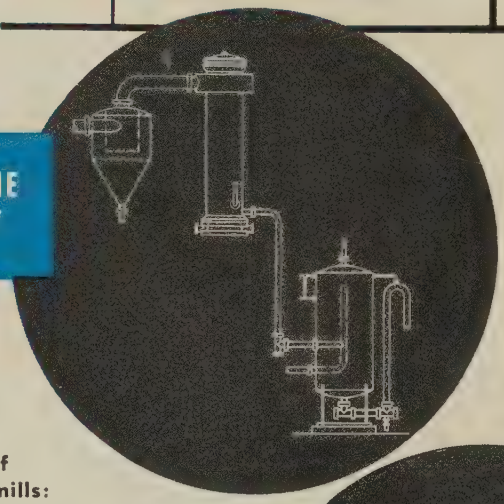
There is another approach which might be looked upon as idealistic, but it should go a long way toward solving the problem. Its practicability would depend almost entirely upon industry recognizing the real seriousness and the general nature of the situation.

There should be a training school for practical operators. This should be supported by the industry. It should take the form of a small mill with small units of up-to-date design. It should be used solely as a training ground for senior operators.

This mill should be supervised by trained practical operators. It might be operated under the joint guidance of the Superintendents' Association and TAPPI.

The mill would not be operated in the normal manner. Instead, the trainee would be subjected to predetermined problems—organized operating difficulties, such as a superintendent must face from time to time. The problems would be largely of a practical nature. They

a *plus* factor in the paper dollar



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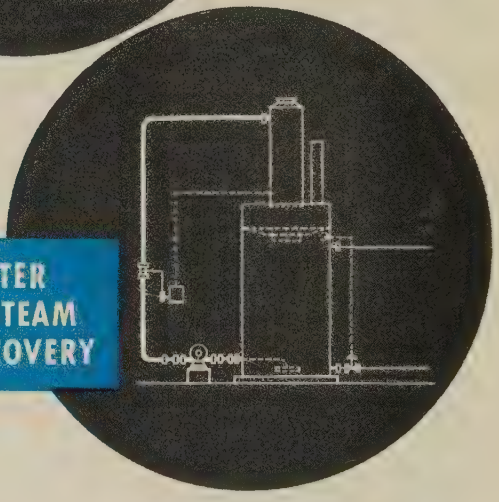

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would be varied and extensive. In this way ingenuity would be tested, and capacity would be measured. Before completing the course the trainee would operate the mill as superintendent. He would be given responsibility for production, efficiency, and costs.

This training course would provide a means of appraisal before promotion, something which is now impossible, by other means. A better means of appraisal before advancement would save the industry many millions. One difficulty in operating this plan might be to determine a proper method of selection of trainees. This might be done be appointment, and should bear a relation to the number of employees in the mill of a contributing firm. Incidentally, I can suggest no better location for a training school than Kalamazoo.

The important point is that industry has a problem on its hands which is not only serious, but difficult to solve. As time goes on the solution does not appear to be getting nearer. Instead, there are so many conflicting factors that the future becomes more obscure.

Thirty years ago the industry faced a challenge. Higher quality, closer control, and more production were urgently required. Through individual effort and with the support of these two associations, the challenge has been met. The challenge of materials and methods has now been replaced by the challenge of men. The problem is yours. No group in any industry is more capable of finding a solution.

Presented at the 17th annual "Papermakers Get-Together," Kalamazoo, Mich., Jan. 10, 1952.

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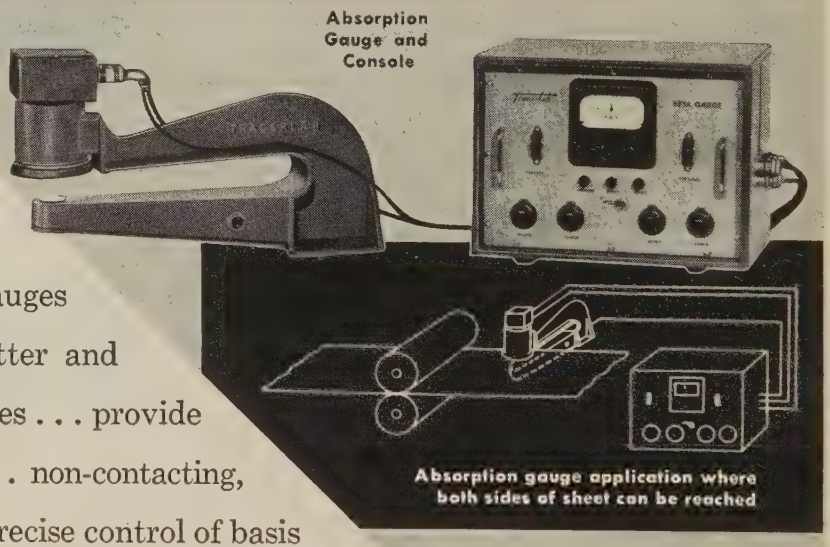

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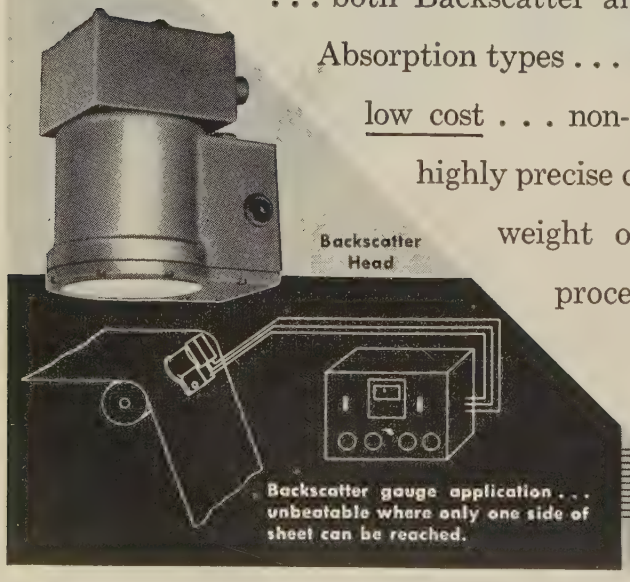

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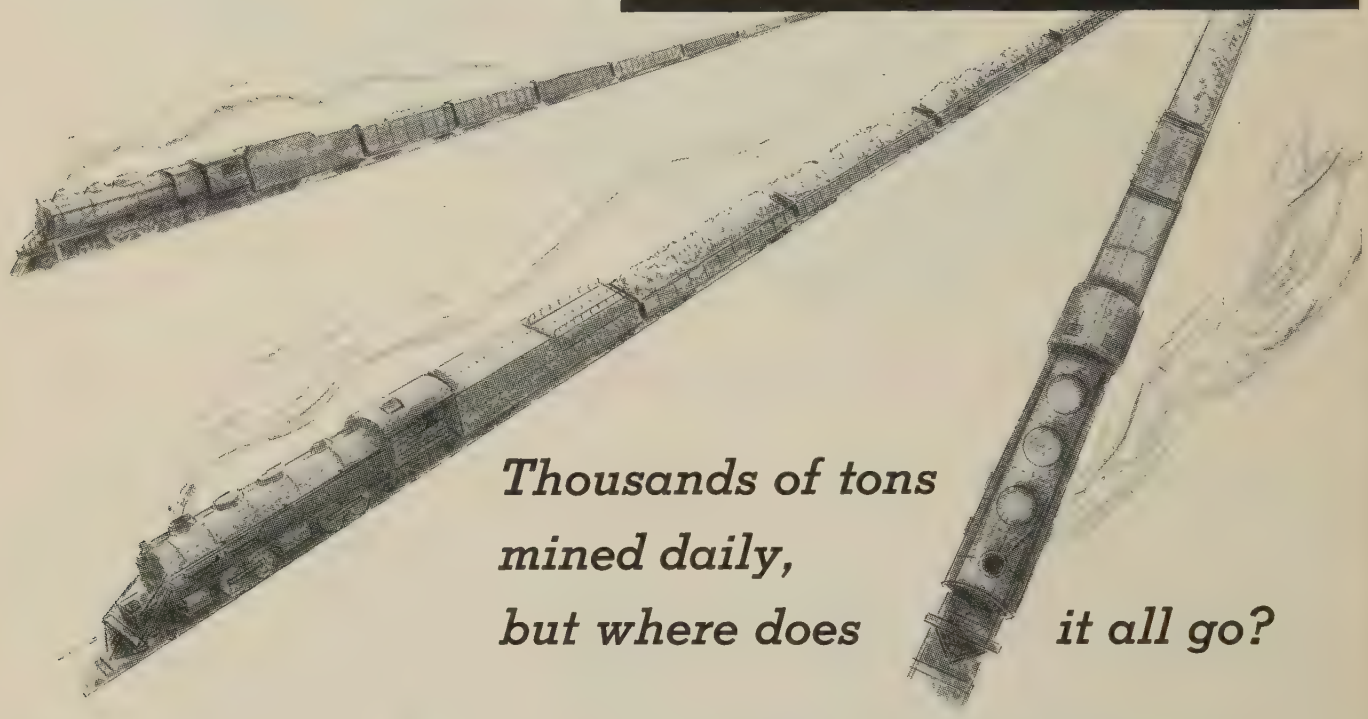

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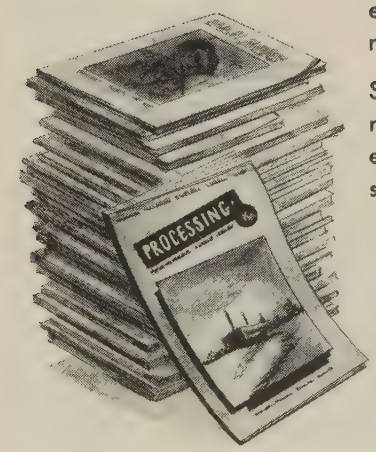

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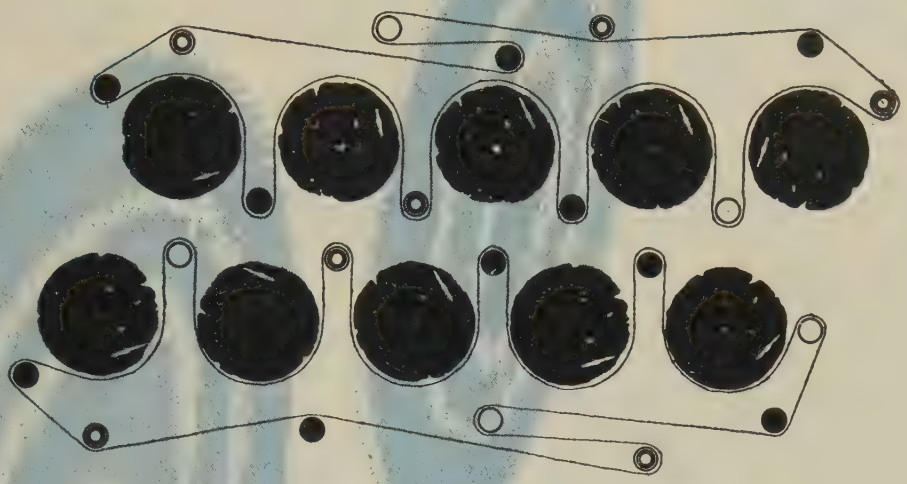

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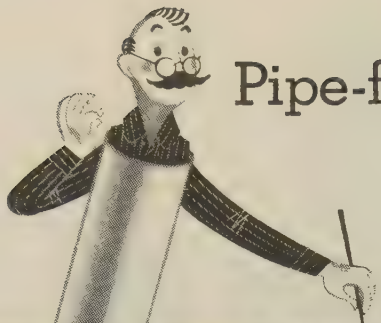

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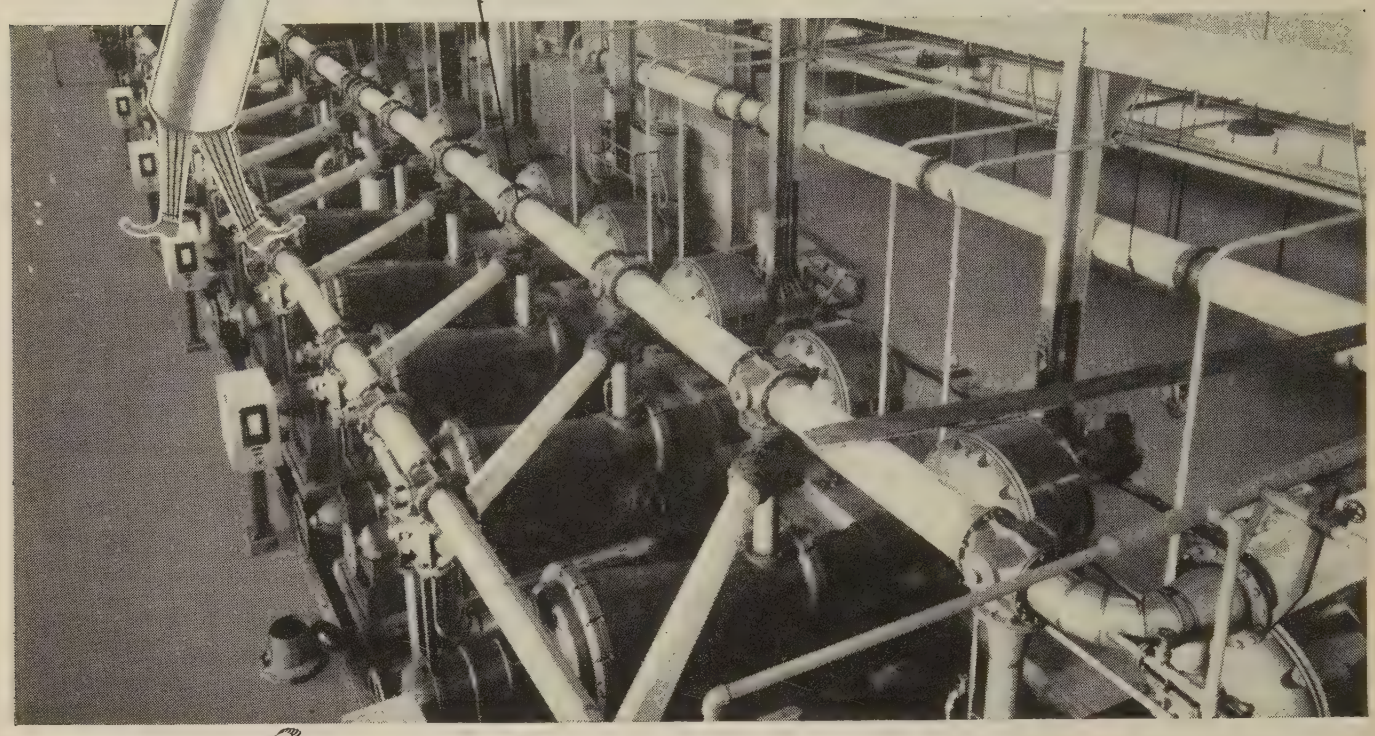

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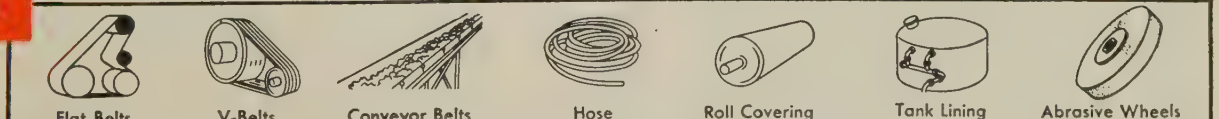

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TREND IN WOOD PULP PRODUCTION

In the 50 years which have elapsed since the beginning of this century, production of wood pulp by United States mills has increased from about 1 million tons (*1*) to nearly 15 million tons annually. Progress was particularly rapid between 1939 and 1950, when production increased 112% (Table I). During this period there was a very marked increase in the production of bleached and unbleached sulphate pulps based largely upon the southern pines and Douglas-fir of the Pacific Northwest. Another outstanding development was the increased use of hardwoods for the production of pulp by the semichemical process. McGovern (*2*) reports that in 1939 this process was used by only two companies with total mill capacities of slightly less than 400 tons per day, compared to thirteen companies with total daily mill capacities of 2115 tons in 1950. This trend is particularly significant because it points toward a greatly increased use of hardwoods, which are relatively abundant east of the Mississippi River.

CONSUMPTION OF PULPWOOD AND OTHER FIBROUS MATERIALS

The total consumption of pulpwood increased from 10.8 million cords (*3*) in 1939 to 23.7 million cords in 1950. This is a gain of 108% in the consumption of softwoods but a 220% gain in the use of hardwoods, as 1950 hardwood consumption was 3.2 million cords (*4*).

In 1950, 56% of the pulpwood was consumed in the Southern and Appalachian regions. The remainder was consumed about equally by mills in the Northeast, Lake States, and the Pacific Northwest. These three regions experienced moderate increases in wood use in the last decade, but in the South pulpwood consumption has nearly doubled in the last ten years.

There has likewise been a rapid gain in the consumption of other fibrous materials, from 5.5 million tons (*1*) in 1939 to 9.3 million in 1950. Much of this increase has been due to an expanded use of waste paper which now amounts to approximately 8 million tons per year.

RECEIPTS OF PULPWOOD AT U. S. MILLS

The pulpwood required by our pulp industry is chiefly from domestic sources although this varies by regions. Pulpwood receipts in 1950 totaled 22.6 million cords (*3*), only 1.9 million of which were imported from Canada. Dependency upon imported wood is greatest in the Northeast and in the Lake States, the former obtaining one third and the latter one fourth of its wood from Canada (Table II). To date the Southern and Appalachian mills have operated entirely upon locally produced wood and it is expected they will continue to do so if appropriate measures, aimed at growing more timber and using a greater variety of woods, are continued.

Fresh impetus to the production of domestic pulpwood will soon develop as the proposed new and expanding pulp mills in the South and other regions come into production. In the South alone, if all projected construction is completed, there will be an additional requirement of about 4.5 million cords annually. This will bring the annual production of domestic pulpwood close to 25 million cords, not counting the requirements of new capacity in other areas.

TIMBER SUPPLIES AND TRENDS

In view of the tremendous and growing demand for pulpwood, it is imperative that the pulp and paper industry consider every practical source of raw material including timber species now little used. A brief review of the over-all timber supply for the Nation shows that in 1945, the latest year when uniform statistics were available, there were 4.6 billion cords (*5*) of softwood timber in sound merchantable trees and 2.3 billion cords of hardwoods, a total growing stock of 6.9 billion cords.

Annual growth of softwoods was 96 million cords, compared to a drain for industrial and domestic use of 116 million cords (Table III). Thus, the use of softwoods, our major pulping species, exceeded growth by 21%, even back in 1945 when total pulpwood production was only three fourths of the 1950 rate. The excess of drain over growth was especially severe on the Pacific Coast, in the South and in the Lake States, all of which are important pulpwood-producing areas.

Hardwoods show a different picture. In all major regions the growth of sound hardwood trees exceeded drain. Thus, for the Nation as a whole, annual growth amounted to 102 million cords and annual drain 85 million cords. This favorable balance should not be accepted blindly, however. A number of the more desirable hardwood species are being heavily overcut, and the better-quality saw-timber and veneer-size trees are declining in volume in the South, the Lake States and the Northeast. This means that the lumber and veneer industries will be forced to draw more heavily upon the sizes suitable for pulpwood or that some of the products formerly made from these larger-sized trees will be made by the pulp

Table I. United States Production of Wood Pulp, 1939 and 1950

Kind of pulp	*1939, 1000 short tons*	*1950, 1000 short tons*	*Increase, %*
Sulphate			
Bleached	424	1,422	235
Semibleached	[a]	375	...
Unbleached	2538	5,711	125
Total	2962	7,508	153
Sulphite			
Bleached	1217	2,111	73
Unbleached	729	745	2
Total	1946	2,856	47
Soda	442	523	18
Other	1643	3,940	140
Total wood pulp	6993	14,827	112

[a] Not available

Source: U. S. Department of Commerce, Pulp, Paper, and Board Industry Report VII, No. 1: 9 (March, 1951).

James W. Cruikshank, Chief, Division of Forest Economics, Southeastern Forest Experiment Station, Asheville, N. C.

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Table II. Source of Pulpwood Received by United States Pulp Mills, 1950

Region	Domestic, 1000 cords	Imported 1000 cords	Imported %
Northeast	2,241	1064	32.2
Appalachian	1,708	..	..
South	11,541	..	..
Lake States	1,985	498	25.1
Pacific Northwest	3,226	289	8.2
Total	20,701	1851	8.2

Source: U. S. Department of Commerce, Pulp, Paper, and Board Industry Report VII, No. 1: 7 (March, 1951).

and paper industry. An example might be fruit and vegetable containers, such as the recently developed corrugated carton for citrus fruit.

Let us now consider for a few moments the situation with respect to the timber species upon which the pulp industry depends most heavily. There appear to be no current statistics on a nationwide basis that show the quantity of the various tree species consumed for pulp. We do know, however, that the several species of southern pines provide nearly half of the Nations's annual cut of pulpwood; that spruce, balsam fir, and jack pine provide at least three fifths of the domestically produced pulpwood in the Lake States; that spruce and fir constitute more than two thirds of the domestically produced pulpwood used by Northeastern mills; and that Douglas-fir, western hemlock, and the true firs are leading species utilized in the West.

In the South, as a result of heavy timber drain and lack of adequate forest management, the pine growing stock has been steadily reduced. Recent findings of the Forest Survey in Mississippi, South Carolina, and Florida show an average decline of about 13% in growing stock since the mid-1930's. Areas of hardwood types have been steadily increasing with a consequent reduction in the amount of land growing pine. In some local areas, however, there are signs that fairly recent improvements in fire protection and timber management are reversing this trend as greater numbers of young trees fill in the gaps in the timber stands. A recent analysis by the Forest Service, which allowed for the benefits we might expect in the next two decades from additional planting, more and better fire protection, better timber management on more land, and other positive developments, indicated that it will be reasonably safe to increase the cut of pine in the states from Virginia to Florida, but that a reduction in cut should be made in the rest of the South. That was the situation as of the first of 1951. Since then, proposed pulp-mill expansions in the Atlantic coast states, requiring over 2 million cords of pine, have claimed the surplus and as of now there are few, if any, areas in the South that could be recommended as locations for pulp mills planning on large open-market purchases of pine.

In the Lake States the situation has been well summarized by E. L. Demmon, former Director of the Lake States Forest Experiment Station, in a speech before the Technical Association at Detroit in 1946. He said, "An analysis of the supply and demand as regards spruce, balsam fir, and jack pine pulpwood shows an alarming stituation. The supply of spruce, the most valued pulpwood species in the Lake States, has declined greatly in recent years, forcing pulp mills to use increasing quantities of balsam fir, jack pine, hemlock, and aspen. The jack pine situation is no more favorable than that for spruce. Accessible stands are heavily depleted and there are no appreciable uncut areas except in Northeastern Minnesota."

The Northeastern picture is much the same. Spruce and fir resources are declining, and the estimated annual growth of the spruce-fir forests is less than one half of the present pulp mills' wood requirements.

Conditions in the Pacific Northwest are less clear cut. In general it can be said that there is an exceedingly tight requirements-and-supply situation based on the use of hemlock, spruce, and true fir logs of large size and high quality for sulphite pulp. There are, however, opportunities for further development of the pulp industry through the greater use of smaller, lower-quality material, thinnings, and species such as Douglas-fir and lodgepole pine.

SOURCES OF ADDITIONAL CELLULOSE

All the evidence points to a declining supply of the kind and species of timber preferred by the pulp and paper industry. In the face of this, the industry is planning a very marked expansion, possibly as much as 40% more annual capacity in the South alone. Obviously, there is need to consider ways of developing additional sources of cellulose. Two possible approaches are suggested. The first, which will bring results rather promptly, is to make more effective use of the materials already available; the second, a longer-term approach, is to grow more timber of the species and quality needed.

The first thing seen when you gaze into the crystal ball in search of new pulping materials is that many people have been doing the same thing for a long time. Tests have been made of most potential materials, various pulping processes have been worked out, and some so-called new materials are already in commercial use. Therefore, I propose merely to bring to your attention some of the sources of cellulose that hold promise for greater use by the pulp and paper industry.

Logging Waste in the Pacific Northwest

In the Pacific Northwest there are an estimated 12 million cords (*6*) of logging waste annually, 35% in pulping species other than Douglas-fir. It is composed of trees knocked down and otherwise damaged in logging and marginal value cull and "wood" logs too poor in quality for the production of lumber. Estimates of the recoverable volume vary, but sample surveys report from 25 to 50 cords per acre.

The development of hydraulic log barkers has contributed to the increased use of logging waste. However, at present it is more expensive than manufacturing waste because of high logging costs, and the pulp industry has used relatively small amounts. Hammond (*7*), of the Weyerhaeuser Timber Co., estimates that cull and wood logs, together with small prelogged timber, provide approximately 4.5% of the wood used in sulphite mills of the region and about 25% of the wood used in sulphate operations. This amounts to roughly 400,000

Table III. Volume, Growth, and Drain of Timber on Commercial Forest Lands of the United States, 1945
(Million Cords[a])

Region	Timber volume Total	Timber volume Softwoods	Timber volume Hardwoods	Softwoods Annual growth	Softwoods Annual drain	Softwoods Difference	Hardwoods Annual growth	Hardwoods Annual drain	Hardwoods Difference
Northeast	781	238	543	9.9	7.9	+ 2.0	24.6	16.2	+ 8.4
Lake	349	100	249	2.5	4.6	− 2.1	9.8	6.5	+ 3.3
Central and Plains	378	25	353	1.5	0.8	+ 0.7	22.4	19.4	+ 3.0
South	1949	833	1116	50.2	52.9	− 2.7	44.2	42.4	+ 1.8
Rocky Mountain	698	678	20	10.2	5.9	+ 4.3	0.3	0.1	+ 0.2
Pacific Coast	2723	2696	27	22.1	44.3	−22.2	0.5	0.1	+ 0.4
Total U. S.	6878	4570	2308	96.4	116.4	−20.0	101.8	84.7	+17.1

[a] Cord volumes derived from inside bark cubic foot volumes on the basis of 70 cubic feet of softwoods or 65 cubic feet of hardwoods per cord.

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cords, or only 3% of the total annual supply. Obviously, here is a tremendous source of supply for new mills if means can be worked out to collect this logging waste at a competitive price.

Sawmill Waste in the Pacific Northwest

The use of sawmill waste has progressed rapidly in the Pacific Northwest in recent years due in large part to the development of satisfactory hydraulic log and slab barkers. A number of pulp mills obtain a major part of their wood requirements from barked slabs and edgings of adjoining sawmills, while others purchase chips from outlying sawmills. Sulphite plants obtain about 5% (*7*) of their total wood from sawmill waste; kraft mills, using chiefly Douglas-fir, obtain an estimated 50%, resulting in a total use of about 700,000 cords annually. Altogether, there are about 4.5 million cords (*8*) of sawmill waste, in the form of slabs, edgings, and trimmings, produced annually, but a high proportion, possibly 80%, is used for fuel. With other fuel materials available, it can be expected that more of this material will be used for pulp.

Little-Used Species in the Pacific Northwest

In addition to the wood that can be obtained in the Northwest through more intensive use of logging and mill waste, there is an immense source of cellulose in "little-used" species. Among these are lodgepole pine, Engleman spruce, Alaska yellow-cedar, and mountain hemlock, having a combined volume of about 25 million cords. There is another species, however, that has been almost completely overlooked. This is red alder, that makes up more than half of the total hardwood volume. It is a short-fibered wood, but, according to Chidester of the Forest Products Laboratory, it can be used in the kraft process for most paper qualities and can be pulped with the semichemical process for paperboard. Altogether, there are about 20 million cords growing along the streams of Western Oregon and Washington.

Unused Timber in the Rocky Mountains

Moving eastward to the Rocky Mountain region we come to a broad area containing millions of cords of Engleman spruce, white fir, western hemlock, and lodgepole pine. Prior to 1950 there was no pulp manufacturing industry in this area although small quantities of pulpwood have been shipped to other regions in recent years. In 1950 Potlatch Forests, Inc. started operation of a kraft mill at Lewiston, Idaho, and within the last few months a Certificate of Necessity has been granted to the Columbine Development Co. for a bleached sulphate pulp mill near Newcastle in Colorado. There is ample timber for these, and a number of other mills, but because of water and power problems, long distances from markets, and costly logging operations, only limited development of the industry in this region is expected.

Greater Use of Aspen in the Lake States

In the Lake States the use of aspen as a substitute for scarce softwoods has become well established, but there is an opportunity to use still more. There are an estimated 33 million cords of standing timber which will yield an annual cut under a conservative form of timber management of about 2 million cords. The present use of aspen for all purposes is less than 1 million cords per year.

Cull Hardwoods in the South

Turning now to the South, we find a region where hardwoods make up 55% of all the sound wood, but account for only 10% of pulpwood production. Analysis of this hardwood resource shows that trees of saw-timber size suitable for lumber and veneer are decreasing in quantity, while young sound growing stock of pulpwood size is increasing at a rather rapid rate. There is considerable opportunity to utilize more of these small-sized trees for pulpwood, but many of them should be retained as growing stock to replenish the saw-timber stands.

Table IV. Sound Timber Volume in Cull Hardwoods in the South

State	*Soft hardwoods,*[a] *thousand cords*	*Hard hardwoods,*[b] *thousand cords*
Alabama	13,500	21,000
Arkansas	9,200	37,600
Florida	14,000	21,700
Georgia	13,400	13,700
Louisiana	10,600	18,400
Mississippi	6,400	27,300
North Carolina	8,900	23,400
Oklahoma	300	5,500
South Carolina	15,100	13,700
Tennessee	2,600	24,000
Texas[c]	5,000	13,800
Virginia	7,600	11,300
South	106,600	231,400

[a] Species such as the gums, yellow poplar, soft maple.
[b] Species such as the oaks and hickories.
[c] Excludes volume in post oak belt.

There is, in addition, a vast volume of wood in so-called cull trees that should be removed from the forest. These are trees that are of such poor form, so knotty, or in some instances so defective, that they are not now or never will be suitable for saw timber. A very large proportion are entirely suitable for pulpwood. Altogether, there are about 100 million cords of sweetgum, black and tupelo gum, yellow poplar, and soft maple, and about 230 million cords of cull oaks, hickories, and other hard hardwoods (Table IV). The net growth of this material is estimated to be about 10 million cords per year.

Until recently the pulp industry of the South has largely overlooked the fact that hardwood pulps have many fine properties, but this situation is rapidly changing. Proposed expansions announced during the first six months of 1951 will require about 4.5 million cords of wood annually, $1^1/_4$ million of which will be hardwoods. This will more than double the use of hardwood pulpwood in the South. Two or more pulp mills will use the gums and other soft hardwoods for the production of dissolving pulps, but a large share of the new capacity will utilize the semichemical process. Much of this pulp will be mixed with pine pulp under controlled conditions for the manufacture of corrugating and liner board. Economies are effected because of the high yields obtained from the hardwoods. Other pulping processes also appear entirely feasible. Among these are bleached semichemical pulps for book papers, specialties, and cover stock. Another important use might be newsprint. The Forest Products Laboratory has made excellent newsprint containing as high as 40% semichemical hardwood pulp, and it is likely that by using the light-colored southern species the hardwood content can be increased even higher. Southern hardwoods are especially adapted to high-yielding pulping methods, such as the neutral sulphite semichemical process. These processes can be controlled to yield 75% or more of moisture-free pulp from almost any hardwood. The pulp and papers are of good strength and suitable for a wide variety of uses.

Scrub Oak in Florida and Texas

The scrub oaks of the South are in a somewhat different category. The wood is dark colored, removal of the bark is difficult, and techniques for processing and cleaning the chips have not been worked out. However, the trees are abundant and are used for little except fuel wood. In Florida there are 2 million acres of scrub oak stocked with about 7 million cords and in the post oak belt of Texas there are about 30 million cords. Additional volumes are found in the rest of the southern states. Although further research in pulping the various species of scrub oak is needed, the Forest Prod-

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ucts Laboratory has found that corrugating board made from blackjack oak semichemical pulp was equal or superior to comparative commercial boards (*9*).

Pine Logging Waste in the South

Logging waste is another source of additional pulpwood in the south, where the annual production of pine lumber is about 8 billion board feet. For every thousand board feet of lumber, the logging segment of the industry leaves an estimated $^1/_4$ cord of pulpwood in the woods, mostly in the upper stems which are too small for sawlogs. This amounts to about 2 million cords each year. The pulp industry has made commendable progress in utilizing this logging waste, but it is doubtful that over 800,000 cords are harvested. Thus, 1.2 million cords are left in the woods. With close cooperation between the logger and the pulpwood producer, more of this volume could be utilized, although there will always be some tops too scattered to justify harvesting.

Chippable Pine Sawmill Waste in the South

Sawmill waste in the South is not as large a source of pulping material as in the Pacific Northwest, but substantial volumes are produced. Studies by the Southern Forest Experiment Station, New Orleans, La., show there is ½ cord of chippable waste produced for each 1000 board feet of pine lumber sawn (*10*). With an average annual production of 8 billion board feet of lumber, the total yield of chippable waste would be 4 million cords, equal to one third of all the round pine pulpwood used by southern pulp mills in 1950.

At present, part of this waste is sold for fuelwood and part is burned for generating power at the larger sawmills. Also, because small portable mills saw two thirds of the lumber the slab piles of the South are scattered throughout the woods making collection difficult. Added to this is the, as yet, not entirely solved problem of removing bark from the slabs. In spite of these deterrents, it is probable that the use of sawmill waste will increase, and a number of companies are investigating the possibility at present.

Other Sources of Cellulose

There are a number of other less important sources of cellulose in the South which deserve brief mention. Cores from the 650 million board feet of veneer logs consumed annually are an excellent source of pulpwood. Some are used, but a larger volume would be available to the pulp industry if the veneer plants would use coal instead of cores for fuel. Pine shavings, produced in large quantities at lumber concentration yards, might be used to supplement round wood in some instances. One pulp mill in the Southeast has been doing this for a number of years.

In the field of agricultural waste products there is bagasse, the waste material of the sugar cane industry in Louisiana and Florida. The amount produced is not large, possibly 900,000 tons annually. Part of this is used by the Celotex Corporation at New Orleans, and most of the rest is burned for fuel. Substituting oil or natural gas as a fuel at the sugar mills would release the bagasse for a higher use. This is proposed at Clewiston, Fla., where the United Bagasse Cellulose Corp. has announced plans for building a newsprint mill.

MORE PULPWOOD THROUGH BETTER FORESTRY

In conclusion, I would like to emphasize the need for better forestry—the long-term approach to an abundant supply of cellulose. In the South, to take an example, present timber yields are less than one half the amount that could be grown under good management. Progress is being made, but there is need for a much more widespread application of better forestry practices. This must include establishment of adequate fire protection on all forest lands, bringing on-the-ground management advice to most of the 1.6 million small forest owners, reducing annual losses due to insects and disease, planting some part of the 33 million acres now poorly stocked or denuded, increasing ownership and management of timberland by forest industries, and general adoption of conservative cutting practices on that 50 to 60% of all forest land which is now subject to poor or destructive cutting. If these measures are put into effect fairly soon, it is estimated that within 50 years annual yields of timber in the South would increase to 150 million cords, nearly 70 million more than at present. This would assure ample supplies of cellulose for the southern pulp and paper industry.

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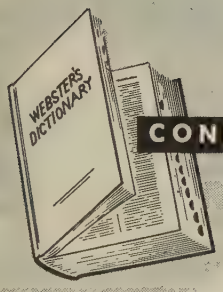

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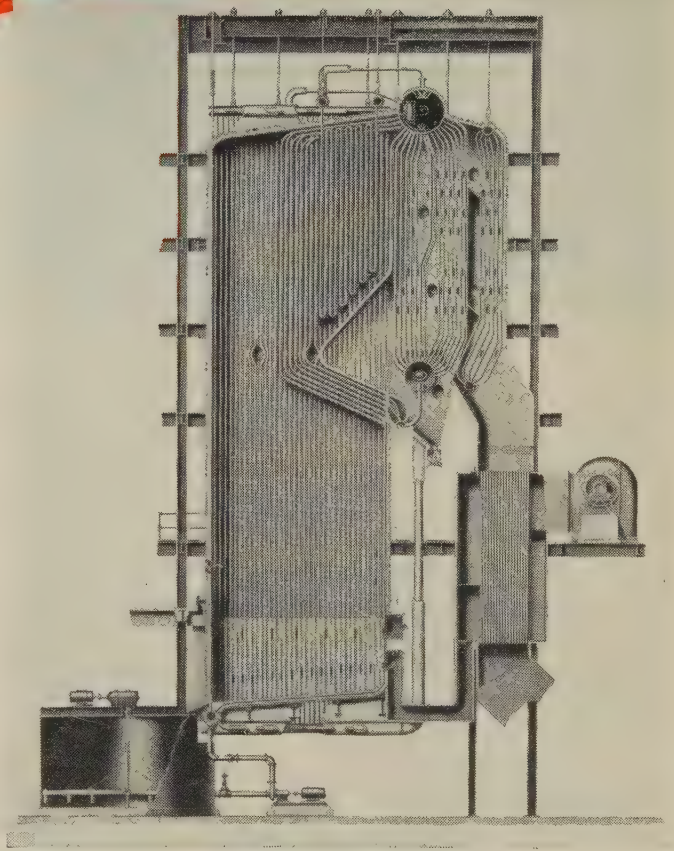

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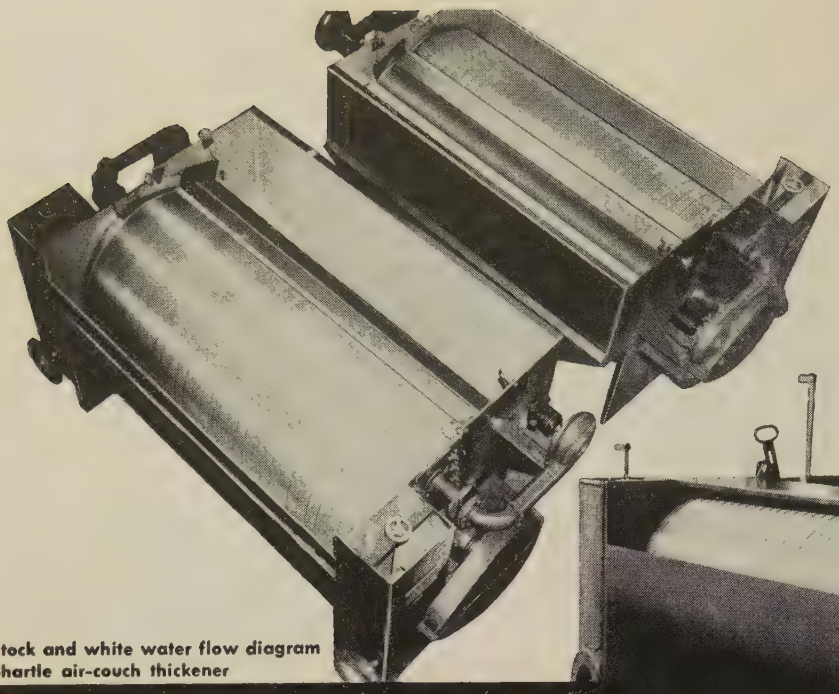

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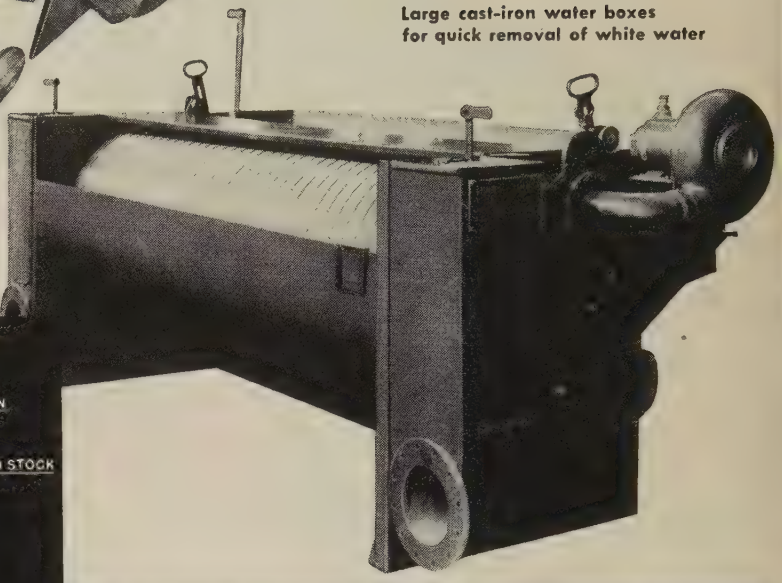
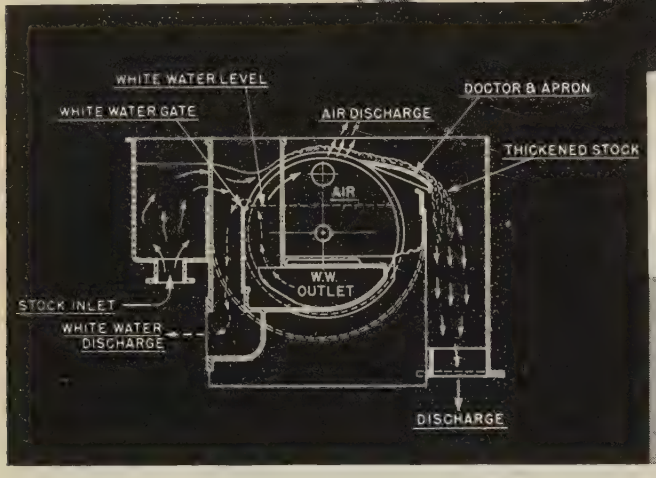


Stock and white water flow diagram
Shartle air-couch thickener



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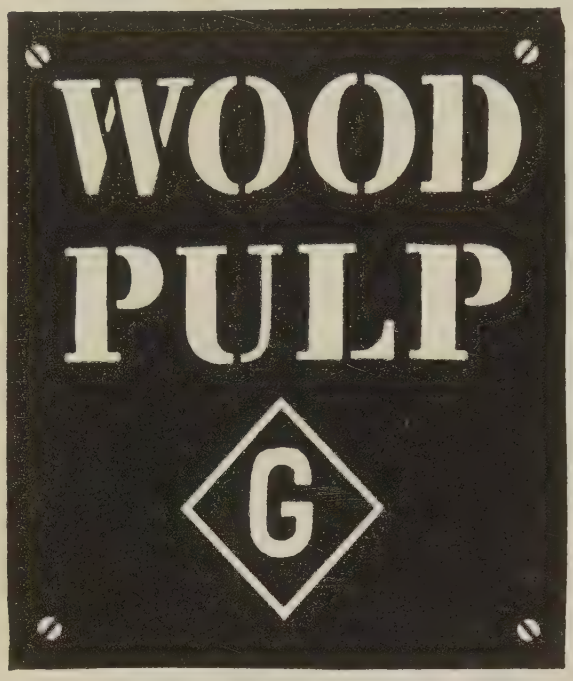

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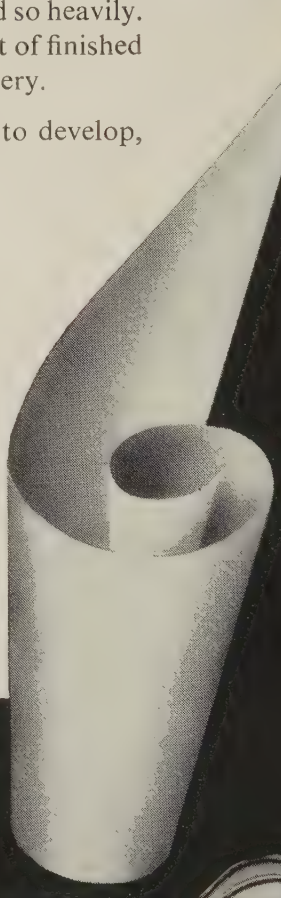

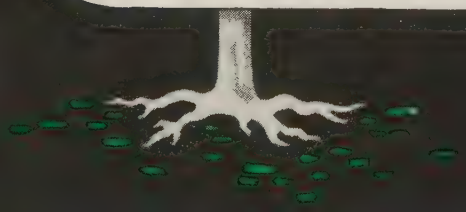

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Early Paris post office. Illustration from Bettmann Archive.

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Older than paper, far older than printing is the idea of a postal service. It began in primitive Persia, flourished in ancient Rome. Even through the "Dark Ages," Merchant Guilds carried it on. But a King of France, Louis XIV, in 1653 first extended postal service to the individual. For a sou, the Paris post office would deliver a letter to your private abode.

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Building Code Problems of the Insulation Board Industry

CHARLES M. GRAY

I AM pleased to have this opportunity of discussing the building code problems of our industry with you who are directly concerned with the production of our various insulation board materials and the resulting structural and fire-resistive characteristics of these materials which are of primary importance in my building code work. As you may realize there is a trend in building codes to place more and more restrictions upon combustible materials which is a result of several tragic fires occurring within recent years. It is, however, possible to build fire-safe buildings with combustible materials properly used and installed to prevent the rapid spread of fire and my efforts as Building Code consultant for the Insulation Board Institute are directed to a great extent in endeavoring to obtain regulations permitting such proper use of combustible materials in new building codes and revisions of existing ones.

The realization of the need for legal control of the construction of buildings to guard the health and safety of the occupants is venerable with age. The first historical record of any building code goes back to nearly 2000 years before the birth of Christ when the code of Hammurabi in ancient Babylonia provided penalties for the builder of faulty construction. This was an eye for an eye type of document and provided that the builder should be put to death if the collapse of a building which he erected should kill the owner. Likewise the builder's son, daughter or slave would be put to death if the owner's son, daughter, or slave had been killed in the tragedy. Our building codes have been greatly improved since the days of Hammurabi in placing proper penalties where they rightfully belong, but much can still be accomplished in the public interest especially in seeing that proper provisions are set forth in the codes and that they do not become instruments to place certain industries in favored positions by legislating against their competitors.

It is generally accepted by building code authorities that the province of such legislation is to provide minimums which are necessary for safety to life and health, but unfortunately many codes are written which go beyond these necessary minimums. This condition arises due to certain influences which frequently affect the preparation of a building code, such as local tradition which is the case of St. Louis and Denver where frame construction is practically ruled out since the local brick manufacturers were able to assure discrimination against frame construction in the earlier codes and now the public generally demands brick construction even in the limited areas where frame residential construction is permitted. It is also frequently the practice to form a building code committee with the more prominent architects and engineers of the community on the committee and these men are only familiar with the more expensive buildings in their practice and inclined to feel that a building code should guarantee the best in construction rather than the necessary minimum for safety. I have also encountered this same type of thinking in Washington which is unfortunate since it is obvious that more and more pressure is being brought to bear on building codes at the national level.

The general public is becoming building code conscious as evidenced by the numerous articles carried in magazines and other publications in recent years due in the major part to the high costs of postwar construction and an endeavor to place much of the blame on restrictive building code provisions which rule out modern building techniques and materials. Whether this criticism is justified or not, it has resulted in a wave of building code modernization throughout the country. Many of these new codes are strongly influenced by one or more of the four building codes of national scope, namely the National Building Code of National Board of Fire Underwriters, the Southern Standard Building Code of the Southern Building Code Congress, the Uniform Code of the Pacific Coast Building Officials Conference, and the Basic Code of the Building Officials Conference of America including the short forms of the P.C. B.O.C. and B.O.C.A. Codes for smaller municipalities. These four codes are also extensively used by many municipalities for the local code, adopting one of the codes as written or with some changes to fit local needs or desires. This use of the four building codes of national scope is indeed fortunate for our industry since all of these codes have very rational regulations of our various structural insulation board materials with few unnecessarily restrictive provisions.

The Basic Code of the Building Officials Conference of America, together with the short form or Abridged Building Code for smaller communities, was published last year after five and one-half years of effort on the part of building officials and construction experts from all sections of the country. The basic code was the first code to recognize the bracing strength of structural fiberboard sheathing, permitting our sheathing both in $^1/_2$-inch and $^3/_4$-inch thicknesses without additional corner bracing when vertically applied in 4 foot by 8 foot sheets. The proposed New York State code for one and two-family dwellings has followed the basic code in this respect, but only for $^3/_4$ inch thick sheathing. I am, however, endeavoring to get the New York State code to also accept the $^1/_2$ inch sheathing without additional corner bracing when the sheathing is vertically applied in large panels.

The Uniform Code of the Pacific Coast Building Officials Conference has been very fair to our materials in all of the editions of this code for the past several years. There is, however, a new chapter regulating interior wall and ceiling finish materials being proposed for the next edition of this code to be published in 1952 which will place some new restrictions on combustible interior finish. I have attended several meetings of the Fire Resistance Subcommittee, which is charged with the writing of this chapter, and am pleased to report that the chapter as now proposed is rational and not too restrictive in general. The Fire Resistance Subcommittee has accepted an end point flame spread of 250 under the Fire Underwriters' tunnel test for approved combustible materials rather than the end point of 200 which has been extensively used in other codes. This is of real importance to our industry, not only in the Uniform Code, but for use elsewhere such as my work with the National Fire Protection Association which has also accepted 250 in a tentative draft of finish regulations to be mutually endorsed by N. F. P.A. and our Institute.

The first edition of the Southern Standard Building Code of the Southern Building Code Congress was adopted in 1945 and a second revised edition was adopted in 1947. The first two editions of this code prohibited any combustible interior wall and ceiling finish in buildings more than three stories in height. In 1948 I submitted a recommendation for a code change to the Congress on behalf of our Institute, which was accepted by the Congress and which approves combustible interior finish in buildings more than three stories in height when applied to a noncombustible base. The third, or 1950, edition of the Southern Standard Building Code includes this recommended change in Section 704.3 and this code now has satisfactory regulations of all our various structural insulating board materials including wall and ceiling finish.

The National Building Code of the Fire Underwriters has been satisfactory for structural fiberboard materials for many years including the latest 1949 edition of this code. The regulations of interior wall and ceiling finish in this code have been especially helpful in combating efforts to establish

CHARLES M. GRAY, Building Code Consultant, Insulation Board Institute, Chicago, Ill.

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unreasonable restrictions in many of the proposed new building codes since the Fire Underwriters are generally accepted as authorities on fire-safe construction in particular.

As I mentioned previously there is a trend in all of these modern codes to place more restrictions on combustible materials especially on interior wall and ceiling finish which results for the most part in a sincere effort to prevent a recurrence of such recent tragedies as the La Salle and Winecoff Hotel fires, the Effingham and Davenport Hospital fires, the Coconut Grove, Kenyon College, and other similar tragedies. I say that this effort is sincere for the most part because the average official charged with preparing building code regulations desires to establish regulations which are the minimum necessary for health, fire, and structural safety in buildings based upon the occupancy involved, but our competitors in the noncombustible field have not hesitated at times to take advantage of the present fire hysteria to obtain regulations favorable to their materials and thereby to eliminate competition.

There is, however, an answer to this problem of establishing fire safe regulations in building codes without merely establishing severe restrictions on combustible materials which for the most part is favorably received by building officials and other construction code authorities. In the first place, not a single one of these tragedies making national headlines has occurred in a building which could have been built under a modern building code including the four codes of national scope, which I have discussed, and yet all these codes permit the rational use of combustible materials. Furthermore no such tragedy has ever occurred in any building built under such modern codes although fires undoubtedly are occurring daily in the many buildings built under these codes all over the country, which are brought under control with no resulting tragedy making national headlines. It is therefore obvious that the answer to fire-safe construction must lie in some factors other than a mere prohibition of combustible materials.

In an endeavor to determine what is a fire-safe building, let us examine the buildings in which these tragedies have occurred. Several of the worst of these fires occurred in so-called fireproof buildings which were ordinarily accepted as fireproof under the antiquated codes in effect when they were built. Modern thinking, however, realizes that a fireproof building is only fireproof like a steam boiler and that, even though there is no structural collapse, a fire can race through a fireproof building, killing the occupants trapped within it, unless proper construction features are present to prevent such spread of the fire.

A study of the official reports on the recent hotel fires such as the La Salle in Chicago and the Winecoff in Atlanta indicates that the most hazardous conditions contributing directly to the rapid spread of the fire were open shafts such as stairways and elevators and improper fire-blocking of furred out combustible construction. Had these conditions been corrected, these fires would undoubtedly have been brought under control without the resulting tragedies such as numerous fires which do occur daily in properly constructed buildings but never make national headlines since they are brought under control.

The open stairways and elevator shafts plus unprotected clothes chutes were present in the St. Anthony Hospital at Effingham, Ill., which were even more disastrous in this case since the hospital was a two-and three-story structure of ordinary construction with approximately 15,000 square feet of undivided floor area on each floor, which type of construction would not be permitted by any modern code for such heights and areas. The same general conditions were present in the Kenyon College fire where numerous students whose age and physical condition would make escape probable, if at all possible, were nevertheless killed in the tragedy and in which none of our materials were involved, although some biased sources have endeavored to place the major blame on the combustible acoustical materials in the Effingham disaster.

The tragedy in the Coconut Grove Night Club of Boston, Mass., resulted to a great extent from highly combustible decorations such as artifical palm trees and highly combustible fabrics and synthetic leather wall coverings which created a flash fire. However, the most serious condition contributing to the Coconut Grove disaster was the fact that practically all the exits except the main entrance had been locked to prevent the customers from leaving the night club without paying their bills and the dead were piled up at each of these blocked exits. This locking of exitways is a serious problem in all building inspection departments as I discovered during the ten years when I served as Building Commissioner in my home city. It is a common practice not only in night clubs, but in neighborhood picture shows where one boy will buy a ticket to the show and then endeavor to let his friends in free through one of the rear exits and it requires constant effort on the part of the building inspector to keep the owner of such buildings from locking the secondary exits.

Our Institute as well as the National Lumber Manufacturers Association and the Douglas-Fir Ply-wood Association have conducted room burn-out tests in order to provide some sound technical knowledge to be used in establishing reasonable regulations of wall and ceiling finish materials. A series of these tests are under way, at the present time, in the Factory Mutual Laboratories in Boston which are being studied by the National Fire Protection Association and which we feel will be of real importance in our efforts to prepare suggested building code regulations of wall and ceiling finish to be mutually endorsed by N.F.P.A. and our Institute. I am also pleased to report that our new class F flame-resistant fiberboard finish gave excellent results in these tests at the Factory Mutual Laboratories. As you probably know, the class F finish is a new material with a fire resistance treatment as established in the new Commercial Standard, CS 42-49, and is comparable to slow-burning materials under the Federal Test SS-A-118a. We believe that this material is a real contribution to fire safety of interior finish materials to be used in buildings of mass occupancy and that it should receive a wide acceptance by building code authorities for such use.

Tests have also been conducted at the Forest Products Laboratories in Madison, Wis., by our Institute which showed that the same gases were developed and a flash-over occurred in complete burn-out of rooms filled with customary combustible furnishings both in rooms with fiberboard wall and ceiling finish and with noncombustible finish only. The fact that a flash-over occurred in each type of room regardless of the type of wall and ceiling finish was of particular interest to me since I have frequently heard the opinion expressed by firemen that a fire will flash along a ceiling of combustible finish. They always notice this condition when arriving at a fire and breaking the windows or doors to get access for fighting it. I have maintained that this flash-over is caused by an accumulation of unconsumed gases at the ceiling which in the enclosed building have not had sufficient oxygen for combustion until the windows and doors are broken open to provide the necessary oxygen, resulting in the flash-over at the ceiling which is blamed on combustible finish when such material is present and ignored when the ceiling is noncombustible. Our material was blamed for such a flash-over at the ceiling of a store building in Sioux City, Iowa, and yet the material withstood the fire sufficiently to protect the ceiling joists and roof rafters of this one-story structure until the fire was brought under control.

In closing I would like to emphasize the fact that the common term, fireproof building, is a misnomer. In my opinion there is no such thing as a fireproof building, but there is a fire-safe building. Regardless of which materials you use in the construction of a building, be they combustible or noncombustible, the building in its usual use, will be occupied with sufficient combustible furnishings to create a tragic fire unless the building is so constructed as previously suggested.

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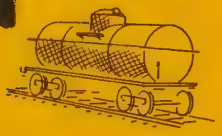

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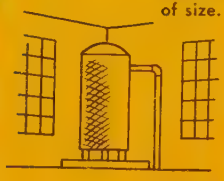

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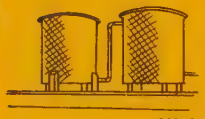

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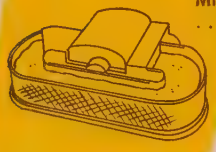

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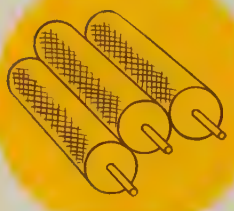

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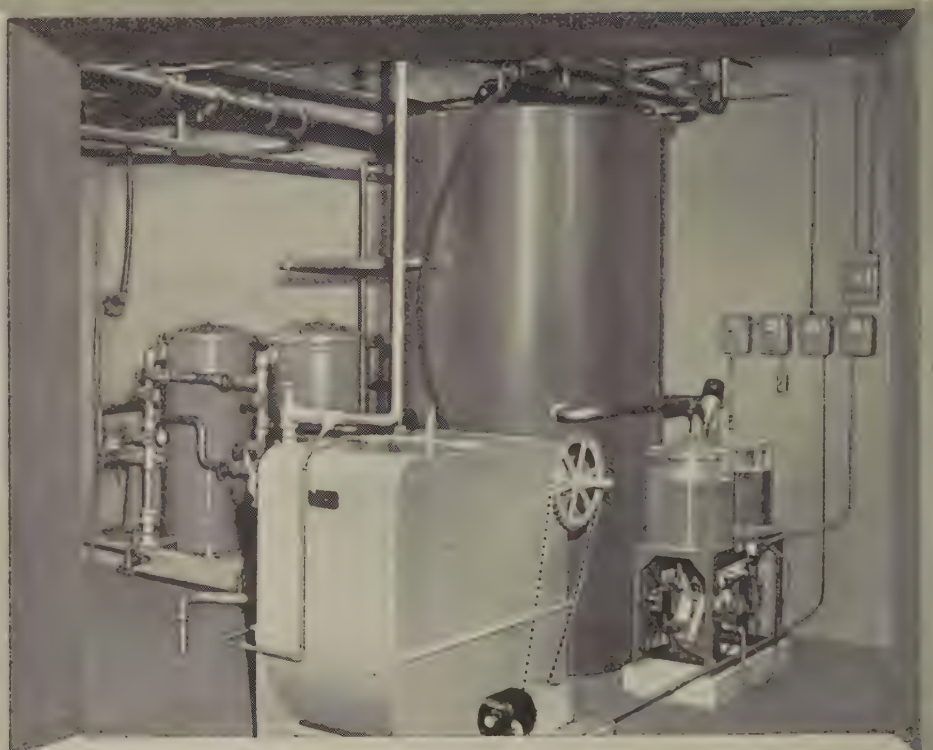

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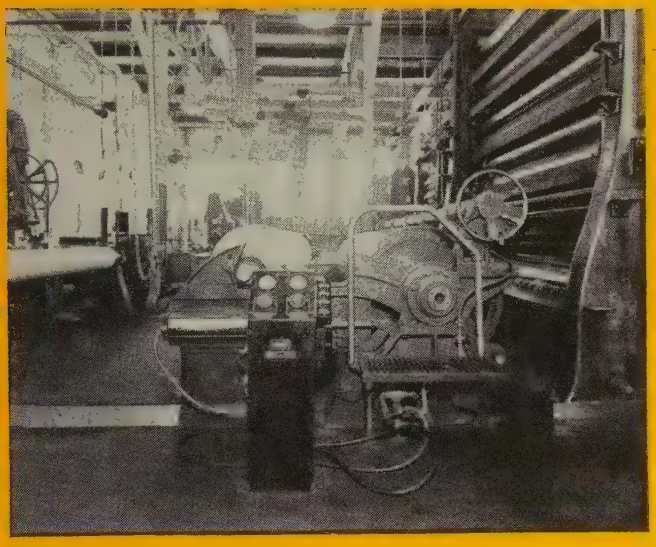

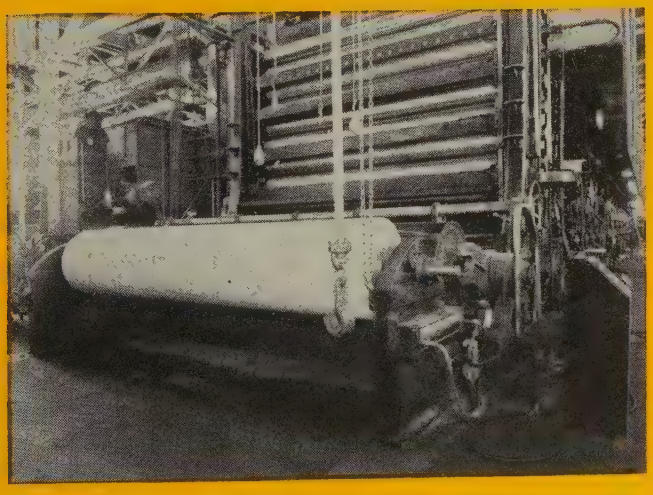

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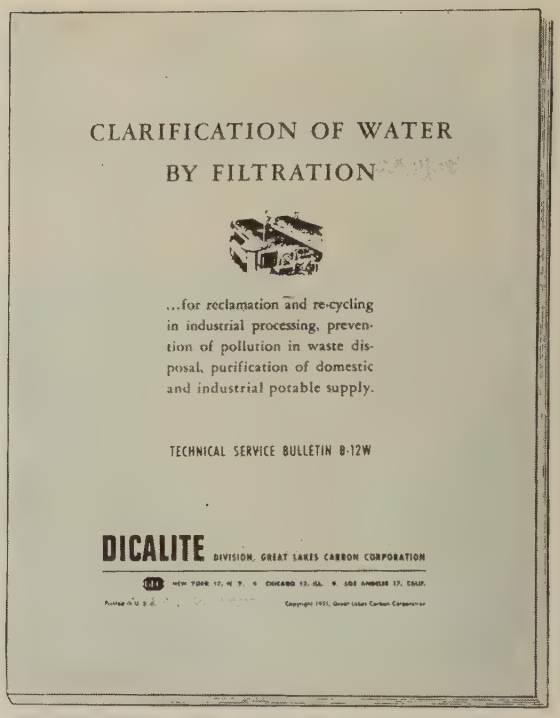
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TECHNICAL SERVICE BULLETIN B-12W
DICALITE DIVISION, GREAT LAKES CARBON CORPORATION

DIATOMACEOUS FILTERAIDS FOR WATER FILTRATION

BULLETIN B-12W contains a section somewhat more complete than Bulletin F-52 on white water filtration, in addition to data on filtering other waters. It covers the general subject of filtration for reclamation and re-cycling water in industrial processing, prevention of pollution in waste disposal, and purification of domestic and industrial potable water supply.

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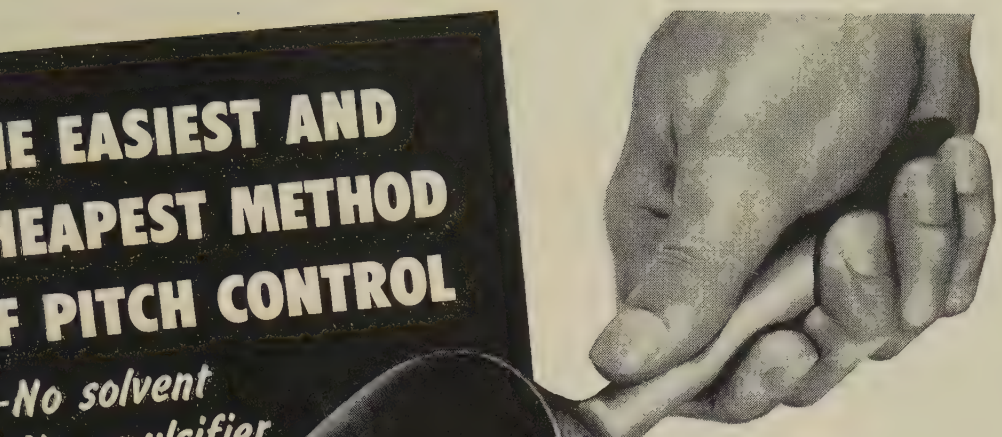

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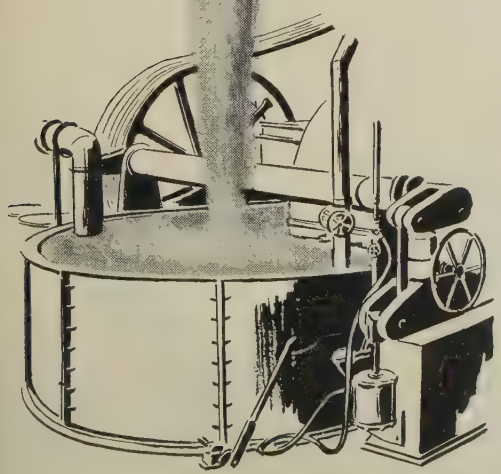

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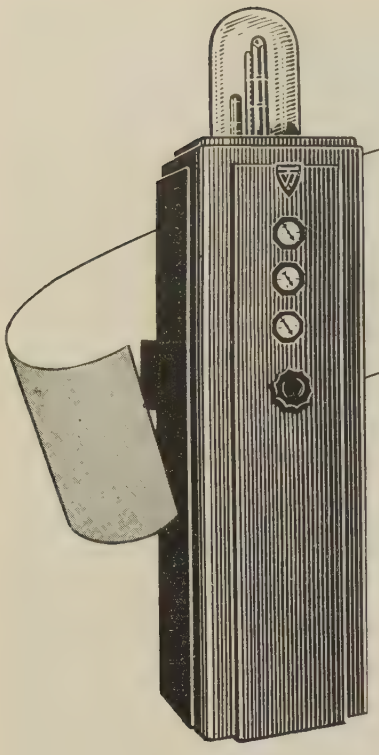

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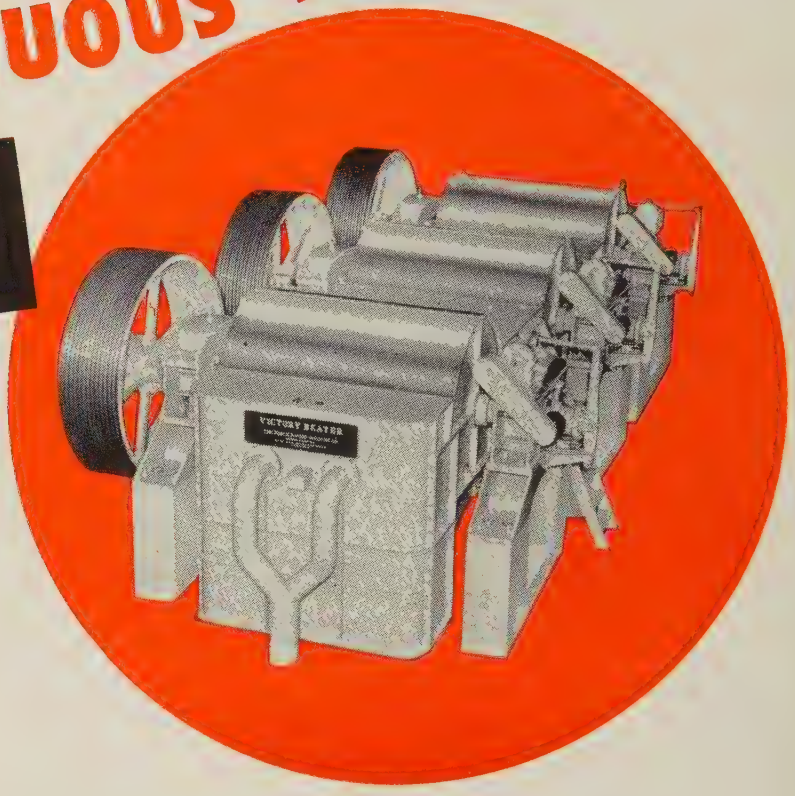

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Mechanical Correction of Two-Sidedness

M. J. LANDBERGE, P. R. SCHREIBER, and H. H. BEHRENS

Two-sidedness due to coloring materials can be corrected by staining one side of the sheet at the size press. Other causes of two-sidedness are given as heterogeneity of fiber furnishes and loading materials. All these are accentuated by increased machine speeds and attendant higher vacuums. Various installations in use for correction of color two-sidedness in the United States and Canada are discussed in detail. It is shown that equipment which is simplest from the engineering standpoint often requires most manual control. A suggested setup is given which demands a minimum of attention by the machine crew. The conclusion is reached that correction of color two-sidedness at the size press is feasible and necessary.

THE problem of two-sidedness of paper which has been with the industry from the time of Louis Robert, Bryan Donkin, and the Fourdrinier brothers has become progressively more acute within the last 25 years because of the tremendous increases in paper machine speeds.

CAUSES OF TWO-SIDEDNESS

This problem as a whole may be broken down into three main subdivisions: structural two-sidedness caused by heterogeneity of fiber furnish, two-sidedness due to loading materials, and two-sidedness caused by coloring matters whether dyestuffs or pigments.

Structural Two-Sidedness

Structural two-sidedness caused by nonuniformity of fiber furnish is readily understood by anyone with knowledge of the operation of a fourdrinier machine and, to a lesser extent, of a cylinder machine. At the instant the stock flows onto the fourdrinier wire or the cylinder face there is a definite separation of the components of the furnish with the fine particles adjacent to the forming wire passing through. The suction exerted by the rotatory motion of the table rolls as well as the disturbance of formation on the wire side caused by alternate application and release of such suction also tend to remove finer fibers from the wire side of the web. The further effect of vacuum exerted by suction boxes and suction couches is to accentuate this condition, and still more of the fines are removed with the expressed water from the press section.

The use of finned table rolls has been found in some cases to minimize the immediate loss of fines through the wire. This improvement is probably due to the fact that the suction effect of a rotating smooth table roll and the washing action of water carried up through the wire are both greatly lessened. A drawback to such an installation may be the slower rate of water removal which would necessitate a longer wire; at the same time there may be some increased wear of the wire.

In any event we are thus faced with a situation wherein the upper surface as well as the interior of the sheet will contain a mixture, as furnished, of longer and shorter fibers while the surface adjacent to the forming wire will contain appreciably less of the shorter fibers or "fines." Such a condition is readily illustrated diagrammatically in Fig. 1.

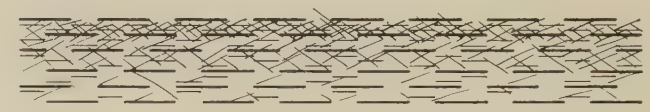

Fig. 1

—fines; —long fibers.

It must not be assumed that this effect is only apparent when working with a mixture of long and short-fibered pulps since in the preparation of any stock for papermaking some breakdown of the fibers must occur. Even if the original pulp consisted of fibers of identical dimensions and density the action of the beating and refining apparatus is such that a heterogeneous stock is delivered to the sheet-forming equipment. Some fibers remain relatively unchanged and others are broken down both along and across the fiber axis to yield short and fine fragments.

The foregoing, while elementary to papermakers, briefly covers a phase of two-sidedness which will probably remain uncorrected so long as paper is made by drainage of water away from a wet web of fibers.

Two-Sidedness Due to Fillers

A second cause of two-sidedness, the presence of loading or filling materials in the sheet, is very closely allied to structural two-sidedness in that particles of filler are removed from the bottom side of the web in the same manner as the fine fibers and fiber fragments. This results in the felt side and part of the interior of the sheet retaining a large proportion of the furnished filler while the wire side of the sheet is practically ashless. Thus we obtain a sheet whose surface appearance, brightness, porosity, printability, and color will vary from top to bottom. This condition is shown in Fig. 2.

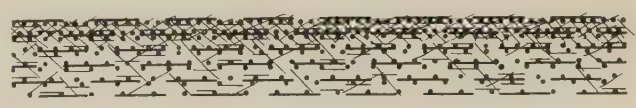

Fig. 2

—fines; —long fibers; . . . . filler particles.

Several methods have been proposed in the past for increasing retention of fillers and fines by means of the addition of glue or other floc-forming material

M. J. LANDBERGE, Member TAPPI; Head of Paper Department, General Dyestuff Corp., New York, N. Y.; P. R. SCHREIBER, Technical Sales Representative, General Dyestuff Corp., Chicago, Ill.; and H. H. BEHRENS, Toronto Sales Manager, Irwin Dyestuff Corp., Ltd., Toronto, Ont.

to trap these fine particles and bind them to the longer fibers. Any such treatment, while improving over-all retention, tends to accentuate two-sidedness since almost all the additional filler retained is held in the upper portion of the sheet; the suction on the wire side more than counterbalances the adhesion of such a pigmented floc to the long fibers on the wire side of the sheet.

Application of filler with an adhesive to the wire side of the web at the wire guide roll has also been advocated. By this means some of the filler removed earlier in passage over the forming table may be replaced and thus the two sides of the sheet be brought into better balance with respect to filler content. Aside from difficulty of control in replacing that amount of filler already lost and the anticipated loss at the suction couch, there may be induced some variation in filler content of the white water which would require continuous adjustment at the beaters to maintain a uniform ash content.

Some mills have made considerable headway in the application of filler to the wire side of the sheet at the size press, a semicoating application. Due to the inherent differences between a size press and a coating press such measures have not been too successful with respect to uniformity of coat weight and ash content across the sheet.

In both the above methods of correction allowance must be made for any difference in color between that of the sheet as a whole and that of the filler. When the latter is applied to the wire side at the size press this becomes a simple matter of color matching. However, the problem becomes more complicated when working at the guide roll since it is inevitable that some of the added color and filler go into the white water both by direct drainage from the wire and through the suction couch. This in turn tends to alter the shade of the felt side of the sheet requiring constant attention to correction of the beater color. Since a great part of the filler and color added at the guide roll is removed at the suction couch the variation noted above may be minimized by running the couch exhaust line to the sewer, entailing high losses. In order to prevent splashing of filler and color up into the sheet when running at high speeds a larger diameter guide roll may be needed.

We thus see that two-sidedness due to loading materials is susceptible to mechanical correction with more or less satisfactory results but only at the cost of considerable attention to control.

Those mills which are coating either on or off the paper machine will find that such two-sidedness may be more readily corrected in the coating process than on the paper machine proper. Such an approach may involve the application of slightly more coating to the wire side than to the felt side and possibly even some duplication of equipment to allow the use of two differently colored coating slurries for the top and bottom of the sheet, respectively.

Before leaving this part of our discussion mention should be made of combination fourdrinier-cylinder and multiple-fourdrinier machines. While it is possible with such equipment to manufacture even-sided sheets, the speed limitations and the multiplicity of variables involved render these of only academic interest in the present instance.

Two-Sidedness Due to Color

This brings us now to the problem of two-sidedness due to color. In the cases of the so-called coarse papers use requirements are generally such that duplex-

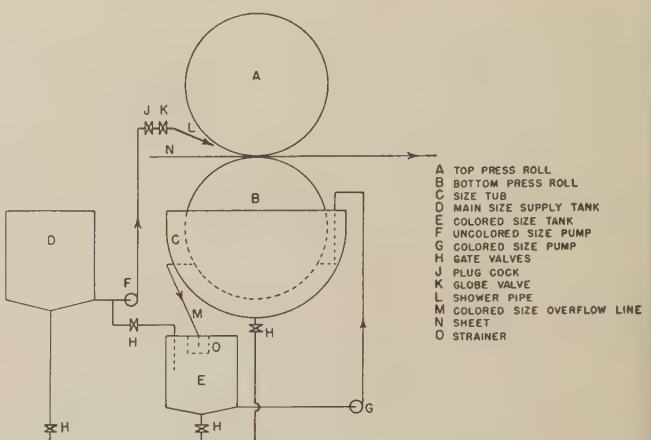

Fig. 3

ity is not a factor and therefore no particular forethought is necessary when selecting coloring materials. For the finer grades which must be as nearly nontwo-sided as possible, proper attention should be given to the selection of dyestuffs. Even so, due to limitations with regard to shade, strength, and economics of all dyestuffs it is frequently impossible to manufacture by normal procedures a sheet of paper which will match in color from felt side to wire side.

In general, there are two main classes of materials used for coloring paper: pigments, both inorganic and organic, and water-soluble dyestuffs. When pigments are used an extremely two-sided sheet is normally obtained; in this case the pigments act like loading materials and are removed from the wire side to greater or lesser extent. Dyestuffs in many cases accentuate the structural two-sidedness of papers: the fines and fibers fragments which have much greater surface area per unit weight than the longer fibers adsorb proportionately much more dyestuff than the longer fibers. Hence sheets are obtained deeper in shade on the felt side where fines are present than on the wire side from which they have been removed. Of course there are exceptions to this statement: some few dyestuffs having as much or greater affinity for the long fibers as for the fines.

In the application of dyestuffs, we are involved with two general types of paper: those containing upward of about 10% filler and those containing less than this amount. We will first consider the heavily loaded sheets.

Certain dyestuffs have greater affinity for cellulosic fibers than for inorganic fillers, others show preferential attraction to fillers, while still others may exhaust on fiber and filler to the same extent. With the first group we find the uncolored filler remaining on the top side of the sheet to contrast with the relatively deep-colored fibers uncovered on the wire side by removal of the filler; this yields a two-sided sheet

deeper on the wire side. With the second group of dyestuffs the highly colored filler is removed from the wire side exposing the lighter colored fiber so that the wire side of the sheet is lighter in color than the felt side which retains the filler. With the third group, which unfortunately is very small, we can obtain a relatively nontwo-sided sheet. From the above it

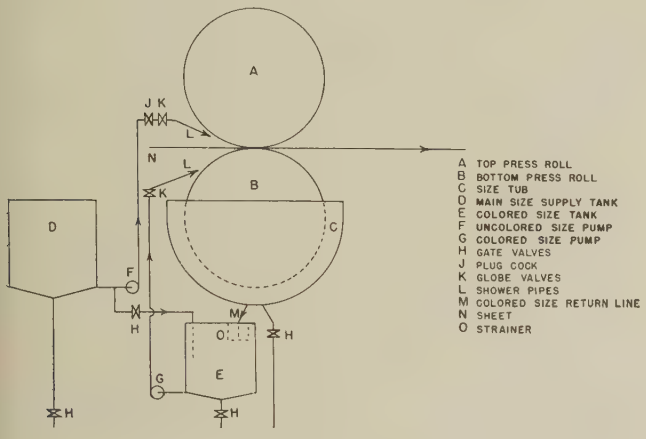

Fig. 4

is readily seen that when a substantial amount of filler is retained in the sheet it may frequently be possible to balance the felt and wire sides by proper choice and manipulation of dyestuffs.

On the other hand, with those papers containing less than about 10% filler it becomes almost impossible to produce a nontwo-sided sheet at high speeds regardless of choice of colorants. The leeway provided between the felt side containing a small amount of filler and the wire side containing practically none has been so narrowed as to remove any area for dyestuff manipulation. The inherent structural two-sidedness is accentuated by the preferential exhaust of the dyestuffs on the fines.

CORRECTIVE MEASURES

We thus arrive at the only likely means of correction: staining the lighter side of the sheet, normally the wire side, to equal the depth and shade of the other side by some mechanical application of a color solution. This may be done either at the wire guide roll or at the size tub.

Correction at the Guide Roll

The same general objections and limitations as previously given for application of filler at the guide roll hold true for application of color. In addition, the color loss to sewer through the suction couch roll will prove to be a major cost item. Frequent adjustment at the headbox and slice as well as constant attention to vacuum at the suction boxes may also be necessary to assure uniform moisture content across the web.

Correction at the Size Press

The logical approach to the solution of this problem is staining at the size tub. Many people concerned with mill operations and production as well as some on the side lines have felt that it is impossible adequately to control such a procedure. The fact that more than a few mills are now operating in this manner at high speeds and are producing even-sided sheets serves to refute this argument. Several of these mills now correcting two-sidedness operate with such close adjustment that they have cut their tolerance of shade difference between felt and wire sides to practically nil. Mechanical correction of two-sidedness is no longer a palliative and a last resort; it is a cure and a necessary one.

Our discussion from here on is concerned with the addition of color to build up the depth of the wire side of the sheet. In those few cases where it is necessary from the standpoint of economics or fastness requirements to use dyestuffs which yield papers deeper on the wire side, the installations described below may be reversed to color the felt side.

An elementary type of installation, but one which is probably the most difficult to operate from the standpoint of control, is based on a separate size supply system for the wire side of the sheet. The necessary dyestuffs are dissolved and the size is colored in batches, circulated to the tub, and allowed to overflow back to the supply tank. Uncolored size is sprayed to pond on the felt side in the nip of the press and is kept from overflowing into the tub by air jets at the edges of the sheet. The main difficulty in control is gradual exhaust of the color from the starch size onto the sheet with consequent weakening of shade and also to some selective adsorption of color by the sheet which causes a variation in shade. In addition, dependence on manual operation of the white starch cut-off when a break occurs may lead to considerable dilution of the colored size. It is readily seen that such a method of operation will require considerable attention to maintain any degree of uniformity during a run. The simple equipment necessary is shown in Figs. 3 and 4.

The next type of setup lends itself to somewhat easier control since adjustment of shade may be made

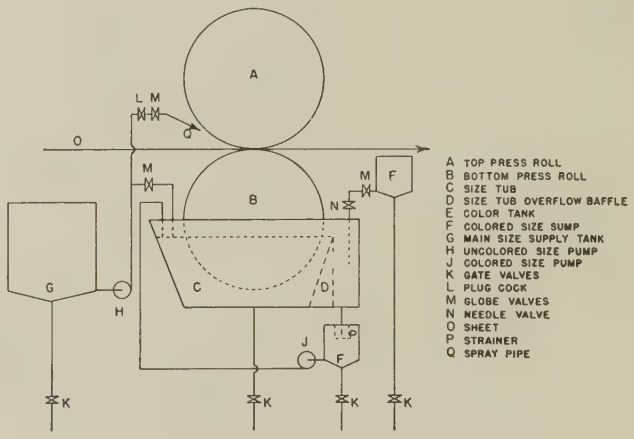

Fig. 5

almost instantaneously from the machine floor. This is shown in Fig. 5. The drawback to this system of operation is dependence on a gravity feed and possibility of plugging of the needle valve used for adjusting flow of color solution. The possibility of change in shade by reason of unequal exhaust of colors is limited by the small volume of the tub and the recirculating storage

tank. However, unless there is careful control of liquid level in the tub and of flow of uncolored sizing solution some variation in depth of shade is inevitable.

A modification of the above wherein the size and color are allowed to mix in a small tank together with the overflow from the tub is shown in Fig. 6. Here flow of uncolored size is governed by a float valve so that less attention is needed.

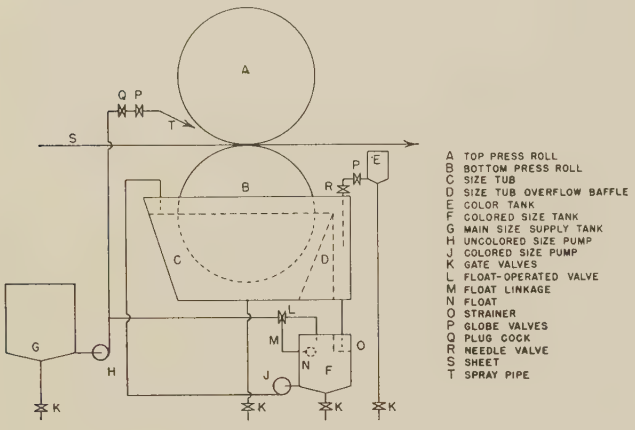

Fig. 6

Thus, by stages, we have arrived at what we believe to be the most easily controlled types of installations. Figure 7 shows one system in which the volume of colored size is kept to a minimum by spraying the colored size onto the lower roll of the size press through very closely spaced shower holes and avoiding the necessity for the roll running in the solution. The dissolved dyestuff is added to the uncolored size by

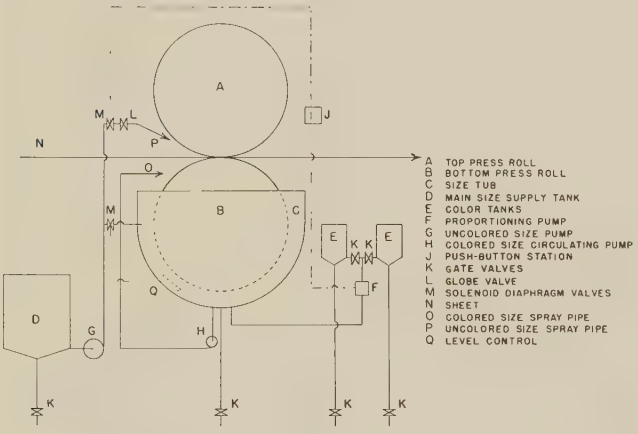

Fig. 7

positive action of a proportioning pump, and its rate of flow is instantly adjustable throughout the necessary range. By maintaining constant volume in the tub correction of color flow to the tub is rapid and accurate. Remote control of both the proportioning pump and flow of uncolored size to the top shower minimizes any dilution of the colored size when a break occurs; at the same time the level-controlled solenoid diaphragm valve will not permit flow of uncolored size to the tub.

In Fig. 8 another installation is shown wherein the volume of colored size is somewhat larger but the level in the size tub is kept constant by the swivel arrangement indicated. The positive feed proportioning pump is capable of adjustment in operation throughout its delivery range. The gap between the pump discharge and the receiving funnel is large enough to allow measurement of rate of flow. The valve controlling rate of flow of uncolored size to the top shower may be remotely operated if desired.

In Fig. 9 is shown a schematic diagram which we believe embodies the best points of the layouts given in Figs. 7 and 8. Relay actuation of shut-off valves in uncolored size lines simplifies operations and tends to eliminate human error and delay which might cause overdilution of the colored size. In this plan

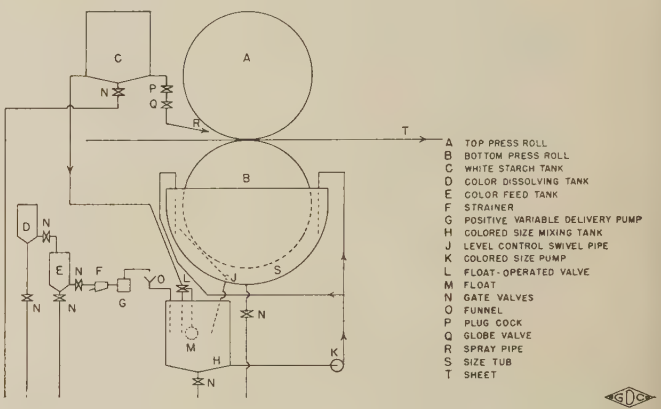

Fig. 8

the only operating variable is adjustment of the ratio of flow of color solution to size at the proportioning unit. Since such equipment is manufactured to permit continuous ratio change while in operation, and also since the volume of colored size is kept to a minimum, it is a quick and easy matter to adjust the depth of shade on the wire side of the sheet. The small amount of colored size eliminates the bugbear of selective

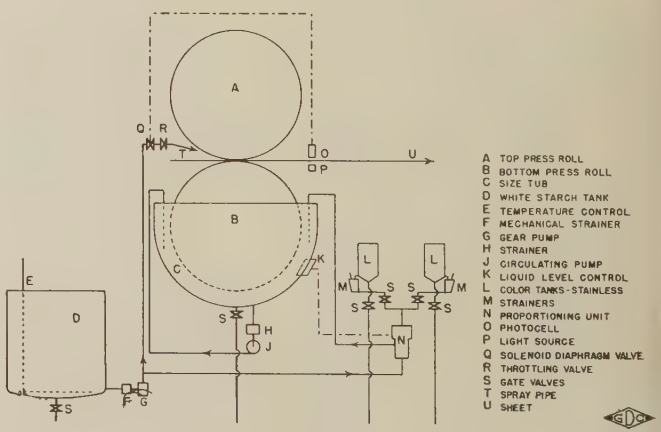

Fig. 9

adsorption of dyestuffs so that once the correct shade is obtained simple adjustments should keep the wire and felt sides in balance.

Of course with any system for mechanical correction of two-sidedness it is necessary to use air jets or similar equipment to control the pond of uncolored size on the felt side of the sheet to prevent its overflowing into the colored size (although a very small overflow or

occasional splash will not appreciably alter the shade of the latter). These are usually made in fishtail shape and should be in adjustable mountings to allow for trim variations; the air supply should not be subject to sudden pressure surges or drops and should be throttled with a needle-type valve. An independent air supply for this application is preferable.

Choice of Dyestuffs

With the matter of equipment thus disposed of, we now come to the choice of dyestuffs for both beater dyeing and wire side correction. We are concerned with the former since it is necessary to use colors which are deeper on the felt side than on the wire side. Fortunately, practically all the dyestuffs used for beater dyeing fall into this category. Those few which appear deep on the wire side are not sufficiently troublesome to bother us—replacements may be found for them, or if necessary, the staining setup may be reversed to color the felt side.

The proper selection of dyestuffs for the staining operation is dependent to a great extent on the specifications to which the paper is being made. If a perfect match is needed, it is frequently possible to correct with the same dyestuffs as are used in the beater since even if these are of comparatively poor solubility the concentrations necessary in the colored size are so low as to be readily attained. Again, if the sheet must be fast to ink eradicator or other chemicals, the dyes used in the beater may be employed for tub correction. However, for most purposes level dyeing acid dyestuffs of good solubility such as are normally employed for surface coloring will be quite satisfactory. The shades may be prematched in the laboratory; translation of formulas to mill operation is normally just a matter of adjusting concentrations.

In comparison with the amounts of dyestuff used for beater coloring the quantities necessary for tub correction of two-sidedness are very small. Even with highly duplex sheets it is rarely necessary to exceed 8 ounces of dyestuff per hundred gallons of tub size. Exact quantities will depend on the specific colors used and on the degree of two-sidedness originally evident. In any event, the depth differential between the felt and wire sides of a two-sided sheet will normally be 10 to 20% and will rarely exceed 40 to 50%. If then the depth of color applied to the wire side varies by 10%, the final variation between sides will usually be 1 to 2% and practically never exceed 5%.

The responsibility for controlling the shade at the size tub is placed on different men in different mills; in some cases it is the colorman on shift, in others the backtender on the paper machine, and in others with several machines having size tubs one man may be designated as in charge of such operations.

We have covered the problem of two-sidedness starting with its origins and working up through means of correction. While we do not feel that two-sidedness can be prevented, it can almost always be cured with reference to color even at high speeds up to and exceeding 800 f.p.m.

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The Cellulose Micelles

BENGT G. RÅNBY

It is suggested that cotton and wood cellulose are built up from micellar strings of a uniform width (~70 A) easy to set free by mechanical treatment (e.g., ultrasonic waves) for investigation under the electron microscope. When hydrolyzed, the micellar strings, retaining their width, are cut into short fragments, i.e., micelles. The latter form aqueous colloidal solutions. The native cellulose micelles have a length of about 500 A. The mercerized micelles are shorter indicating that they are partly fragments of the native micelles. Regenerated cellulose fibers (viscose and cuprammonium rayon) also contain strings of the same width as the micellar strings. After hydrolysis, these strings give very short micelles (100 to 110 A) of a lower absolute crystallinity than the native micelles. All micelle lengths are in agreement with separately measured D.P. values for the nitrates of the hydrocelluloses. The native cellulose micelle as a fundamental cellulose particle, the synthesis of cellulose in the living cell, and the probable difference in fine structure between cotton and wood cellulose are discussed.

More than thirty years ago it was proved by x-ray diffraction that native cellulose fibers were partially crystalline (*1*). During the 1920's it was even possible to use the widening of x-ray reflexes for an absolute determination of the dimensions of the crystalline regions called the crystallites or micelles (*2*). The results were an average width of about 60 A and a minimum length of 600 A for native fiber cellulose and lower values for regenerated cellulose fibers (*3*). These findings were later confirmed by x-ray small angle scattering (*4*). The micelle conception has been further investigated and discussed (*5–12*).[1]

Recently, the micelles have once more become the object of growing interest. Some authors have shown by experiments on the depolymerization of cellulose in fiber suspension that certain parts or bonds of the chains apparently are broken more rapidly than others, i.e., the degradation reaction is not homogeneous. These findings have been interpreted to mean either that the cellulose chains are periodically built up from units comprising chains of a D.P. of 100 to 200 or thereabout, or that the chains are more accessible to chemical attack in between rather than inside the denser packed micelles. Among the published work, supporting such views, the studies of af Ekenstam (*13*), G. V. Schulz (*14*), Nickerson (*15*), Pacsu (*16*), Sihtola (*17*), Bergek

Bengt G. Rånby, Institute of Physical Chemistry, University of Uppsala, Sweden.

[1] In a recent review, E. Heuser (*Tappi* 33, No. 3: 118–124 (1950)) states that "the most recent experimental evidence—as derived from metallic shadow casting, surface replicas, and electron stains—would seem to be in favor of regarding the so-called micelles as being incidental rather than fundamental units."

(*18*), and Kleinert (*19*), seem to be the most important. Other authors have criticized these views.[2]

On the basis of the work mentioned above a series of investigations on cellulose degradation was started at the University of Uppsala some years ago. The main aim was to investigate if there really is a periodicity in

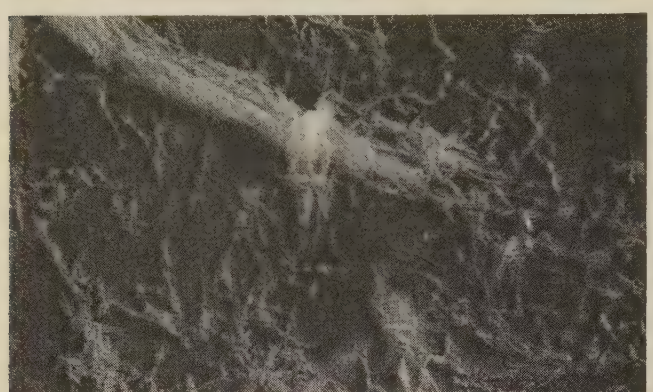


Fig. 1. Cellulose micelles and coarser fiber fragments from a sulphite pulp (bleached and cold alkali refined), hydrolyzed for 1 hour. Magnification 29,000× (1 1/8 inches = 1mμ)

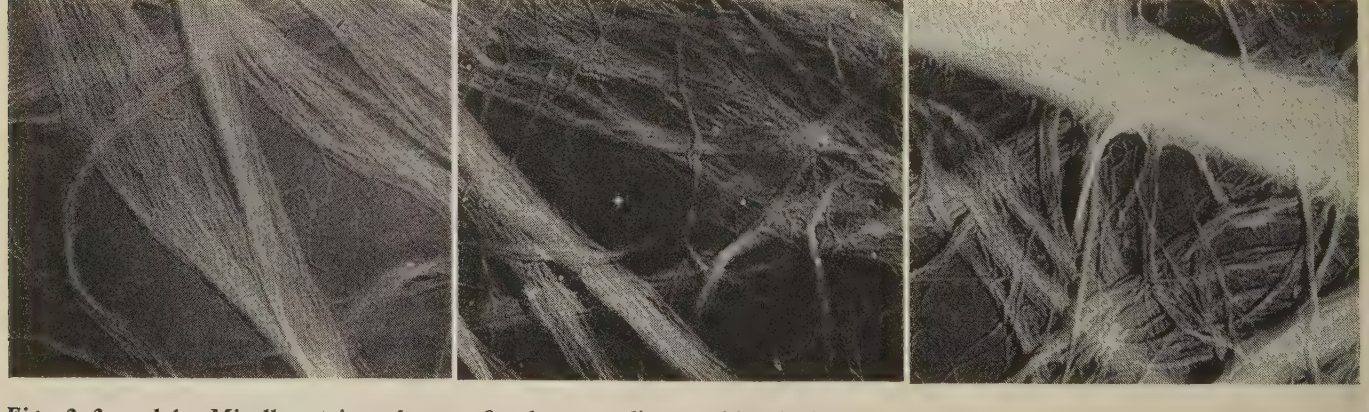
the depolymerization of the cellulose molecules, and if there were, then to study it further. The work in its early stage has been reviewed by Svedberg (*20*) in a lecture, and some notes on it have been published more recently (*21*, *22*, *23*).

ISOLATION OF MICELLES

A detailed analysis of the polymolecularity of different technical wood and cotton cellulose pulps by a combination of fractionation and ultracentrifugal sedimentation of the samples in the form of their nitrates has made it probable that the frequency curves generally are complex, showing several maxima (*24*). Common to the different pulps were, besides the high-molecular cellulose portions, peaks at D.P. values of 70 to 100 and about 200; sometimes even higher multiples of 100 have been observed (*25*). With severe hydrolytic or oxidative degradation the material accumulated in the low molecular peaks. These findings will be further studied.

Depolymerization experiments with boiling 2.5 *N* sulphuric acid, according to Nickerson and others (*15*), led to the isolation of cellulose micelles. The method was simple. After the hydrolysis, the cellulose residue was washed free from acid by distilled water in a preparative centrifuge. When a pH of ~3.5 was reached, peptization of colloidal particles began, giving turbid wash liquids with a bluish opalescence. The particles were of a cellulose nature, and were capable of passing through a fine glass filter (Jena No. 4), indicating that they were very small. In the electron microscope they were visible only after being subjected to metal shadow casting. Figure 1 is one of the first micrographs of the peptized cellulose particles (sulphite pulp, hydrolysis for 60 minutes). All particles are rodlike, and the smallest have a length of about 500 A and a width of about 100 A in this picture.[3] From x-ray and electron diffraction patterns it could be shown, that the isolated particles have a pure cellulose lattice (cellulose I). Thus, in dimensions and lattice, they are identical with the cellulose micelles, earlier postulated from x-ray studies on cellulose fibers (*22*).

In the first experiments only a few per cent of the hydrolyzed cellulose could be peptized as sol. Using hydrolysis for longer periods (10 to 15 hours) about 10% bleached cotton linters (chem. grade) and about 30% bleached sulphite pulp (chem. grade) were obtained as cellulose sols with D.P. values of 120 and 95, respectively. The D.P. values of the residues were 135 and 120, measured viscosimetrically for the correspond-



Figs. 2, 3, and 4. Micellar strings from refined cotton linters, bleached sulphite pulp (hot refined, Billerud SSS), and prehydrolyzed, bleached sulphate pulp (Uddeholm's Cordicel), respectively. The fibers were disintegrated by means of ultrasonic waves in a water suspension. Magnification 29,000× (1 1/8 inches = 1 mμ)

[2] The criticism has mainly been directed toward Pacsu's (*16*) novel concept of the periodical structure of the cellulose chains (Halsall, T. G., Hirst, E. L., and Jones, J. K. N., *Nature* 159: 97 (1947); Heuser, in TAPPI; Monograph Series No. 6, pp. 17–19 (1948); and Meller, A., *Tappi* 33, No. 1: 11–15 (1950)), but the influence of the supermolecular structure (morphology, crystallinity) on cellulose reactions has also been questioned for many reactions earlier supposed to be micellar heterogeneous (Samuelson, O., *Svensk kem. Tidskr.* 58: 285–293 (1946), and Timell, T., Studies on cellulose reactions, *Ingen. Vetensk. Akad. Handl.* No. 205, Stockholm, 1950, p. 63 et seq.).

[3] The electron micrographs published in this paper were obtained by the use of a Siemens electron microscope as described by von Borries, B., and Ruska, E., *Z. wiss. Mikroskop.* 56: 317 (1939), and Siemens Z., 20: 217 (1940). The preparations were made on collodion membranes, spread on a water surface in the customary way (thickness of dry membrane 150 to 250 A.). In some cases, the carrier membrane was given a positive charge from a thin layer of beryllium according to the method described by Ribi and Rånby (*22*). The shadow-casting was made by an alloy of gold-manganin (containing 50% gold and 50% commercial manganin). This material gives excellent shadows with a much finer grain than pure gold. It is easier to use than platinum metals as no alloy formation with the wolfram carrier thread occurs.

ing cellulose nitrates. It was possible also to disintegrate the residues completely into rodlike micelles, free or in aggregates, using ultrasonic waves in water suspension.[4]

COLLOIDAL SOLUTIONS OF MICELLES

The peptized cellulose micelles form aqueous colloidal solutions with a maximal concentration of about 0.5%. The colloids are very sensitive to electrolytes, and they are to be classed as hydrophobic (*21*). They coagulate at ionic strengths as low as 10^{-3} to 10^{-4}, i.e., sometimes in ordinary tap water, indicating that the micelles are not—or at least very little—swollen in water suspension, thus giving the solutions a low viscosity. These findings were unexpected, because fiber cellulose shows a comparatively high water regain. The colloid particles have a negative charge which to some extent may be supposed to be an effect of dissociation of protons from hydroxyl groups. The properties of the colloidal cellulose solutions will be described further in a forthcoming paper. These matters are of a certain interest in view of the numerous discussions on micellar cellulose solutions which were published during the last 25 years (*26*). Apparently solutions such as here described have not been prepared until now.

THE MICELLAR STRINGS

It has been suggested (*22*) that the native fiber cellulose is built up from a framework of thin strings of a diameter close to 70 A (Fig. 2). These strings are easy to set free from pulps by beating or other mechanical treatment in water suspension. Ultrasonic irradiation is an excellent method; this was used throughout these investigations. Such thin strings, which may be called micellar strings, constitute the smallest and probably the only structural elements of the framework of cotton and wood cellulose (Figs. 3 and 4). The micellar strings are apparently of about the same width with a narrow distribution in cotton and wood pulps. The width of the strings were measured with a microcomparator ap-

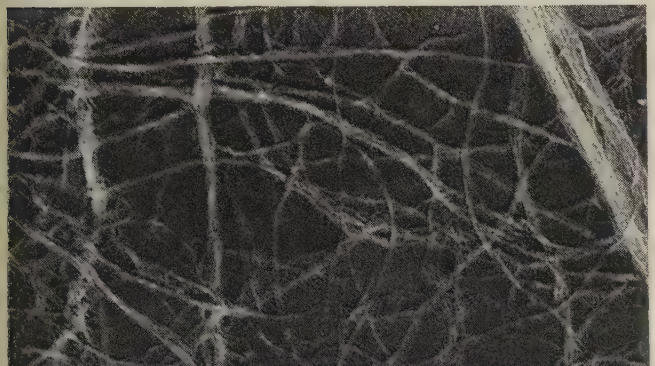


Fig. 5. Micellar strings from refined cotton linters, partly in bundles of some hundred A width. Magnification 29,000× (1 1/8 inches = 1 mμ)

plied directly to the original micrographs of Figs. 2, 3, and 4. The magnification was 8500 ×, giving a micellar-string diameter of 68 ± 15 A. All wider strings are resolved into bundles of micellar strings in the micrographs, and no thinner strings are found on the plates. In some laboratories, elementary fibrils with a diameter of 250 to 300 A have been found (*27*). Although it is possible that such thicker fibrils exist preformed in the fibers, our pictures show them to be built up of micellar strings, as in Fig. 5.

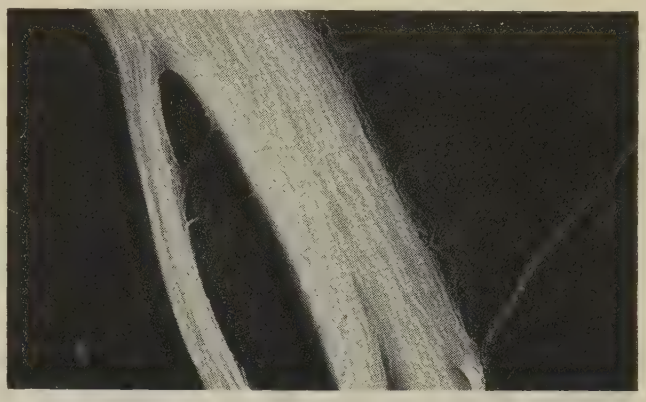


Fig. 6. Fragments of mercerized cotton linters, resolved into micellar strings. Magnification 29,000× (1 1/8 inches = 1 mμ)

The micellar strings resist swelling in strong aqueous alkali, and their dimensions are unchanged after mercerization of the cellulose (Fig. 6). Their inner structure is changed, however, forming the lattice of cellulose hydrate (cellulose II). This will be discussed later to some extent.

DEGRADATION OF MICELLAR STRINGS

Chemical action, causing degradation of cellulose chains, for example hydrolysis in boiling sulphuric acid as previously mentioned, cuts the micellar strings rapidly to rodlike micelles of the same width as the strings (Figs. 7, 8, and 9). The micelles of the same cotton and wood celluloses as used for Figs. 2, 3, and 4 have all an average length of about 500 A, corresponding to a (separately measured) D.P. of about 100 (weight average). In the micrographs the micelles are visualized as small rods, and their existence as defined particles could hardly be questioned. The intermediate stages, indicative of the breaking up of the strings, are often seen as rows of resolved micelles.[5]

Hydrolysis of the mercerized cellulose samples produces shorter micelles of the same width. For cotton cellulose (Fig. 10). the effect of mercerization is not very large, the average length being decreased from about 500 to 350–400 A. For wood cellulose (Fig. 11), the effect is more pronounced: The micelles are still rodlike, and their average lengths are about half of the original i.e., 250 to 300 A.

The average length of the micelles corresponds to the average length of the cellulose chains, as measured for the nitrates of the hydrocelluloses. This is a convincing proof of the assumption that the micelles are well-

[4] The ultrasonic generator used throughout this investigation was of the magnetostrictive type (a nickel transformer as vibrator) with a frequency of 22 kHerz. The energy transformed to ultrasonic waves was about 1 watt per cm.².

[5] Hydrolysis and ultrasonic treatment in connection with morphological investigations of cellulose by electron microscopy, have recently been used by Morehead, F. F., *Text. Res. J.* 20: 549–552 (1950), and Hock, C. W., *Text. Res. J.* 20: 141–151 (1950). M.'s measurements, however, have given micelle lengths and D.P. values for the hydrocelluloses of about three times those obtained in this investigation.

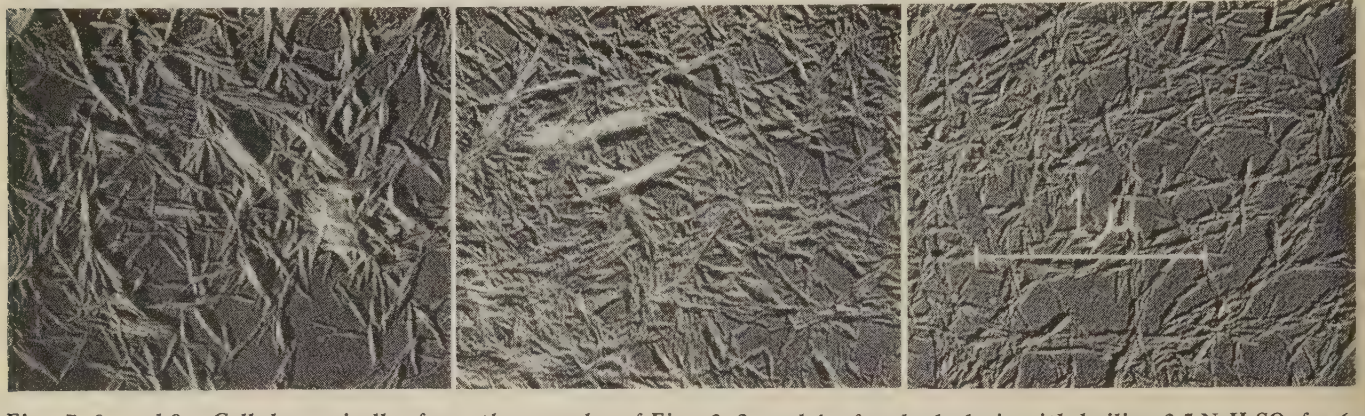
ordered (mainly crystalline) bundles of cellulose molecules. The lengths of the micelles from native and mercerized cellulose are not uniform. The distribution of the widths is narrower measured on the micrographs. This might be an effect of the resolving power of the electron microscope, estimated to be about 30 A, i.e., a third to a half of the micelle width. With the resolving power obtainable at present in the electron microscope, one can hardly expect to reveal a fine structure in as tiny an object as a cellulose micelle.

THE DIFFERENCE BETWEEN COTTON AND WOOD CELLULOSE

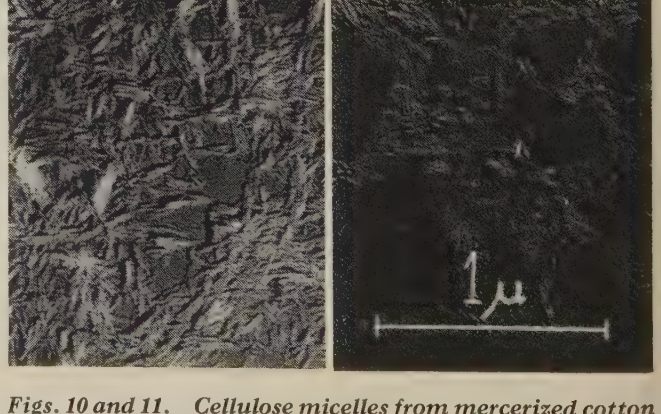
There is vast literature on the differences in fine structure between various types of cellulose fibers, especially between those of wood and cotton (*28*). This subject has again recently been treated by Jørgensen (*29*). The question is of utmost technical importance, since wood pulps have to a great extent replaced cotton linters as dissolving pulps. In the present study only differences between purified wood and cotton cellulose are taken into account. Greater water regain (*30*), greater heterogeneity in chemical reactions, in dyeing etc., and lower alkali concentration for producing the mercerization effect (*31*) were observed for wood pulps as compared to cotton and cotton linters. The heterogeneity is probably an effect of differences in morphology or chemical composition of the whole fiber rather than of differences in the fine structure of the cellulose framework itself.[6] Other differences between wood cellulose and cotton cellulose are more directly connected with the fine structure, and various hypotheses have been put forward in this respect, as shorter, thinner, or flatter micelles or more irregular ones in size and lattice order for wood cellulose. A difference has also been proposed for the structure of the intermicellar cellulose connecting the micelles. Apparently most of these hypotheses have to be discarded in the light of the experiments reported above. As far as measurements on native wood and cotton cellulose micelles have been made, they show the same dimensions and x-ray crystallinity. Wood cellulose becomes mercerized at a lower alkali concentration than cotton cellulose. It is reasonable to assume that this property of the wood cellulose micelles corresponds to their greater water regain. In addition, the water sorption by a native cellulose is intermicellar, as evidenced by the lattice of the micelles which is unaffected in the process. It is probable then that the main difference between wood and cotton cellulose is a greater active surface of the wood cellulose micelles.

REGENERATED CELLULOSE FIBERS

The fine structure of regenerated cellulose fibers has recently been shown to be closely related to that for native cellulose. Mühlethaler (*32*) found a network of thin strings in viscose rayon, and Ribi (*33*), independently in this Institute, found the same network and, in addition, was able to measure the width of the strings and obtain the same value (~70 A) as for native cellulose. After hydrolysis of the viscose rayon, small cellulose particles were isolated from the sol as obtained by peptization (*22*). These particles were shown by Ribi (*33*) to be crystalline micelles of an average length of about 100 A. Similar investigations on the hydrolysis



Figs. 7, 8, and 9. Cellulose micelles from the samples of Figs. 2, 3, and 4, after hydrolysis with boiling 2.5 N H_2SO_4 for 6, 4, and 4 hours, respectively. The washed hydrocelluloses were disintegrated by ultrasonic treatment of aqueous suspensions. Magnification 29,000×



Figs. 10 and 11. Cellulose micelles from mercerized cotton and wood cellulose (Billerud SSS pulp, mercerized), after hydrolysis for 2 hours. Magnification 29,000×

[6] A very promising approach to the elucidation of the accurate chemical composition of cellulose fibers was made by Wise, L. E., et al. (*Tappi* 32: 335–336, 397–398 (1949)) using a combination of partial acid hydrolysis and chromatography for analysis of the carbohydrates (filter paper partition chromatography according to Partridge, S. M., *Nature* 158: 270–271 (1946), and *Biochem. J.* 42: 238–248 (1948)). An important question, not yet answered, is whether or not the nonglucosic constituents of wood cellulose (mainly xylose and mannose) are of intra-micellar origin.

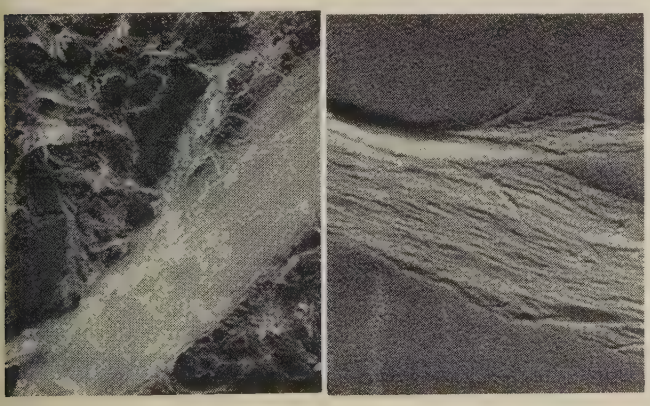
of viscose rayon were published in the U.S.A. (*34*) revealing substantially the same micelle dimensions.

A fine structure investigation was also made with cuprammonium rayon, samples of which were kindly supplied by W. G. H. Robins of the British Bemberg, Ltd., Doncaster, England. After ultrasonic treatment in an aqueous suspension, all yarns were slowly split up into fragments containing thin strings of micellar dimensions (Figs. 12 and 13). These fragments appear partly embedded in the fiber, thus making an exact measurement of their width difficult. However, free-laying strings were found to be 60 to 100 A wide. After hydrolysis and washing out of the acid from this rayon, a sol of micelles was prepared by peptization or ultrasonic treatment of the residue (Figs. 14 and 15). The cuprammonium micelles are well crystallized (cellulose II lattice), giving a sharp electron diffraction pattern (Fig. 16). Their dimensions were measured on the electron micrographs: average width and length are 90 A and 110 A, respectively. The length agrees fairly well with the degree of polymerization of about 20, as measured for the nitrated samples in acetone solution. A more detailed account of the investigations of the cuprammonium rayon will be given in a forthcoming publication.

Further work on the fine structure of regenerated cellulose is necessary to decide whether or not the strings and the micelles from viscose and cuprammonium rayon are of native origin.

THE ABSOLUTE CRYSTALLINITY OF THE MICELLES

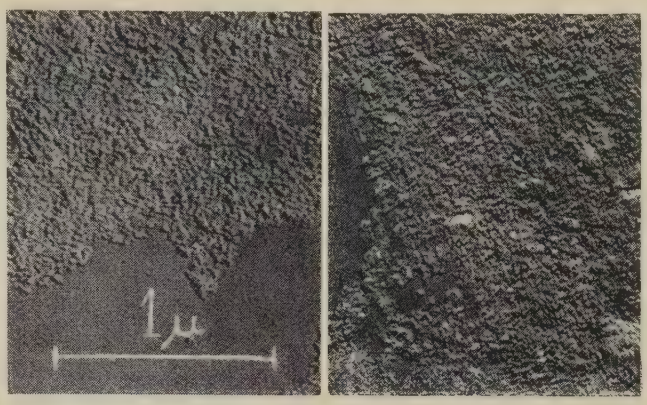
A very important question is the absolute crystallinity of the micelles. X-ray measurements, made by Hermans and Weidinger (*35*), showed both fiber cellulose (cotton, ramie, and flax) and refined wood pulps to have a crystallinity of 70 to 72%, mercerized, refined wood pulp of 48%, and viscose rayon of 39%.



Figs. 12 and 13. Fragments of cuprammonium rayon from British Bemberg Ltd.: a commercial product with a normal D.P. value and an experimental yarn with a high D.P. value, respectively, produced from the cotton linters as used for Figs. 2 and 5. The fibers were disintegrated with ultrasonic waves in water suspension. Magnification 29,000× (1 1/8 inches = 1 mμ)

After acid hydrolysis, the crystallinity of viscose rayon and mercerized wood pulp increased to 60 and 62 to 63%, respectively, whereas that of the wood pulp remained unchanged. Peptized micelles from native and mercerized wood pulp had the same crystallinity as the respective residues. This is not surprising since the residue of hydrocellulose can be completely disintegrated to micelles and micelle-aggregates by ultrasonic waves.

The main point to consider is that the micelles from native cellulose are isolated without change in crystallinity, whereas the micelles from mercerized and regenerated celluloses undergo recrystallization when isolated. It is reasonable, then, to assume that the native micelles are of another nature than the other types.



Figs. 14 and 15. Cellulose micelles from the cuprammonium rayon samples of Figs. 12 and 13, respectively, after hydrolysis for 4 hours. The washed hydrocelluloses were disintegrated by ultrasonic treatment of their aqueous suspensions. Magnification 29,000×

THE SYNTHESIS OF CELLULOSE

Until now, very little has become known of the way in which cellulose is formed in the living cell. A great deal of work has been done and criticized (*36*). Based on the new evidence of the fine structure of the fiber walls, the question could be discussed in the following way.

Native cellulose molecules have an average length of at least 3000 to 4000 glucose units, i.e., 15,000 to 20,000 A = 1.5 to 2 mu. We know that the chains are built up from glucose to more than 95%, but we have no definite proof that they are quite homogeneous or even unbranched in their native state. It is very difficult to understand how chain molecules of this length, after their synthesis, could be joined into bundles, i.e., the micellar strings of such a narrow width distribution, and in addition form regular, well-ordered crystalline regions, i.e., the micelles, in the strings. A much more plausible interpretation of the synthesis is possible if we regard the micelles rather than the molecules to be the primary structural elements. A native micelle has the same mass as many proteins—a molecular weight of 1.5–2 million—and its shape and width are similar to some viruses, for instance tobacco mosaic virus. The native micelle is better crystallized than any other cellulose particle, now known. It possesses a lattice (cellulose I), which can be obtained from free cellulose chains at high temperature and high pressure (saponification of cellulose acetate by hot water is one example). According to a phase study[7] of Kubo (*37*), the lattice of cellulose I is metastable and that of cellulose

[7] A careful interpretation of available data of heats of adsorption of water and alkalies by cellulose has shown that mercerization of the wet cellulose is an *exothermic* reaction at room temperature. A thermodynamic treatment of the wetting and swelling of cellulose will be published in *Acta chem. Scand.*

II stable at room temperature. These observations improbable that native micelles (cellulose I) should crystallize from free cellulose chains in the cell. There seem to be at least two possibilities: that the micelles are pre-formed in the protoplasm, linked together into

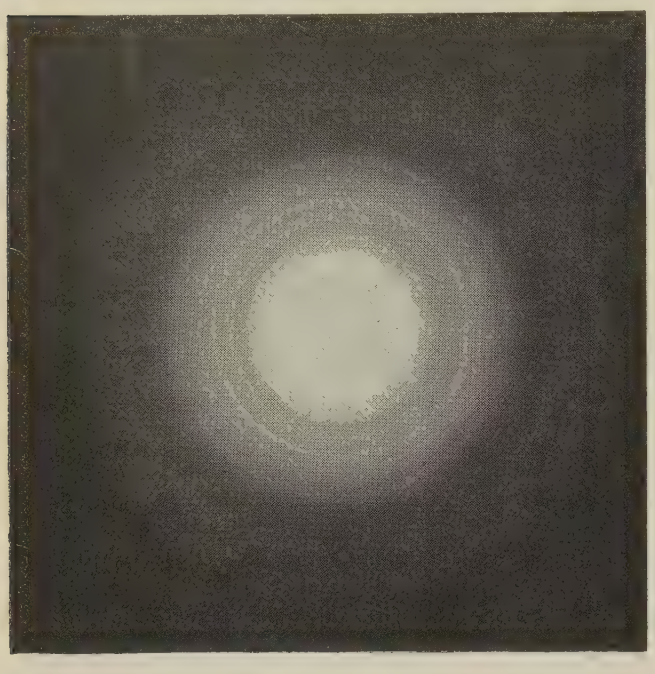


Fig. 16. Electron diffraction pattern of cuprammonium rayon micelles (commercial yarn, hydrolysis for 4 hours)

strings, and deposited upon the cell wall, or that the chains are pre-formed in bundles and then crystallized enzymatically in a way not reproducible in vitro. The native cellulose micelle as a fundamental cellulose particle has been discussed by Svedberg in a recent address (*38*). However, the author should like to stress that the views as presented in his study, although made probable by experimental evidence, are still to be considered as hypothetical.

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The Chemical Nature of the Cork from Douglas-Fir Bark

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The cork from Douglas-fir bark was examined for its chemical nature. The chief extractive components are dihydroquercetin, waxes, tannin, and a carbohydrate substance, which on hydrolysis gave glucose and galactose. Extractive-free Douglas-fir cork was found to be composed of two fractions: one fraction amounting to 82 to 85% of the dry weight was soluble in alkalies or dioxane-hydrogen chloride reagent; the other fraction amounting to about 15% of the dry weight was thin-walled, cellular material. The composition of each fraction is described. A comparison of Douglas-fir cork with Mediterranean oak cork showed that they are quite similar chemically with the exception of the higher extractive content of the former and the higher molecular weight of the acids in the latter. The common concept of cellulose-fatty acid linkages in cork was not substantiated by the findings of this investigation.

THE presence of cork in the bark of the Douglas-fir, *Pseudotsuga taxifolia* (Poir.) Britt. has been known for many years, but little effort was made to study the chemical nature of this material. Some Douglas-fir bark, particularly from the bottom of mature trees, contains an excess of 50% by weight of cork. The commercial development of a method to separate the cork from the other bark components has made available a domestic source of cork at a cost below that of ground cork from the Mediterranean oak tree (*14*). The present work was undertaken to establish the chemical nature of Douglas-fir cork and to compare it with that of Mediterranean cork.

A systematic investigation of the entire cork substance from the Mediterranean cork oak, *Quercus suber*, Linn., has not yet been made. However, extraction of this cork with inert solvents removes extraneous components, and wax solvents remove a fraction known as cork wax which contains the polyterpene alcohols, cerin and friedelin. De Baun and Nord (*4*), in their attempts to isolate a native lignin from cork by extraction with alcohol, obtained products with an average methoxyl group content of 4.62%, and concluded that their lignin product was contaminated with such phenolic materials as tannin or phlobaphene. The composition of the extractive-free Mediterranean oak cork has been the subject of considerable conjecture. It is claimed to consist of suberin, lignin, cellulose, and glycerides (*18*). Suberin contains hydroxy fatty acids which are said to be chemically united as a polyestolide (*8*) or as an ester of cellulose (*17*).

MICROSCOPIC EXAMINATION OF DOUGLAS-FIR BARK

An anatomical examination of Douglas-fir bark showed that it consists of several components. The inner bark, i.e., the portion of the bark from the wood cambial zone to the cork cambium, is composed of sieve cells, phloem parenchyma, and bast fibers. The entire bark consists of anastomosing lunes of cork in which annual growth layers are usually visible. Interspersed among the yellow corky layers are areas of red phloem tissue that contains brittle, elongated bast fibers and crushed parenchyma. The cork content of the bark varies considerably, depending upon the age of the tree and the position of the bark on the tree, but deep cork formation usually occurs at a relatively early age. The function of the cork is to protect the tree from oxidation and loss of moisture, and to act as insulation against climatic changes.

Microtome sections examined under the microscope showed that the wood rays extend from the wood through the cambial layer and inner bark to the cork cambial layer, but not into the cork. A transverse section treated with a fat stain, Sudan III, indicated that wax was present mainly in the ray cells and the cork cambium. In general, the largest amount of extractives seems to be present in the cork cambium and the first few rows of cells beyond this cambium. That some of the cork cells appear to be partially collapsed is especially noticeable in bark with thin cork layers, and probably accounts for the swelling observed during the extraction of cork with water and inert solvents. Treatment of the cork with sodium hydroxide solution severely weakened the cork structure; the individual cork cells fell apart easily after alkaline treatment and could be individually isolated under the microscope. This indicates that an alkali-soluble substance serves to cement the cork cells together in much the same way as lignin forms the middle lamella in wood. The individual, alkali-extracted cork cells have very thin walls and appear to be cellulosic since they can be dissolved in sulphuric acid.

MATERIALS USED FOR CHEMICAL STUDY

Samples of bark used for chemical study were collected from Douglas-fir trees 2 to 6 feet in diameter and 70 to 300 years of age. Information concerning the samples is shown in Table I. Considerable experimentation was performed in developing a method to separate the cork from the other bark components. The principal problem was to free the cork completely from adhering bast fibers.

The following method was devised and found to give a pure cork product. The fresh bark from Douglas-fir trees was immediately reduced to pieces about 4 by 4 by 12 inches or smaller with a hatchet; the inner bark was chopped off and saved for analysis. The pieces were ground in a hog while the bark was still "green" or wet. This produced cork chips and free bast fibers. The bark was then screened on a 6-mesh sieve, the cork particles being retained on the sieve

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Table I. Collection Data on Douglas-Fir Bark Samples

Sample no.	No. of trees	Tree diam., ft.	Age of trees, yr.	Trees cut, date	Bark obtained, date	Thickness of bark, in.	Thickness of cork layers, in.	Source of bark
1	6	4	200	2/49	4/6/49	6–10	1/8–5/8	Lumber Co. at Wren, Ore.
2	..	...	...	...	3/50	...	...	Silvacon 383
3	5	2	75	3/50	3/1/50	5/8–1 1/2	1/8–1/4	5 miles West of Albany, Ore.
4	4	2	70	8/50	8/9/50	1/2–1 1/2	1/8–3/8	Corvallis, Ore.
5	5	3 1/2	150	8/50	8/30/50	3–5	1/8–3/8	Dawson, Ore.
6	1	5	250	6/48	8/50	5–8	1/4–1/2	From stump at Alsea, Ore.
7	3	4	300	7/50	7/50	2–3 1/2	1/8–3/8	15 miles south of Dawson, Ore.
8	1	6	300	6/50	7/50	7–11	1/4–1/2	17 miles northeast of Florence, Ore.
9	...	...	...	...	...	1–2	1/8–3/8	West central Wash.

while the bast fibers passed through. Since the bast fibers were found to be completely free of cork, they were dried, rescreened, and used for analysis. The cork particles were re-ground in a Krupp mill, an attrition-type grinder, to pass a 5-mesh screen. After air-drying, the material was again screened, re-ground in the Krupp mill to pass a 10-mesh screen, and rescreened. Bark with very thin cork layers was ground to pass a 20-mesh screen. Cork produced in a hammer mill or a ball mill was not satisfactory for this study. The former gave an inferior product because it tended to disintegrate the cork particles, whereas the latter crushed the particles and did not effectively remove the adhering fibers.

This indicates the desirability of separating the cork from the other bark components, or using corky bark when the extraction of dihydroquercetin is intended. The inner bark, which is free of cork, contains only small amounts of waxes and dihydroquercetin, and is similar to Douglas-fir wood in this respect (*7*).

EXAMINATION OF DOUGLAS-FIR CORK EXTRACTIVES

Hexane Extract

The wax extracted with hexane from sample 1a was cream colored, and melted at 57 to 59°C. on a melting point block. It was saponified and the individual components were separated by a previously described procedure (*10*). The analysis showed the presence of 49.3% lignoceric acid, 27.5% lignoceryl alcohol, 9.8% ferulic acid, 0.6% phytosterol, 8.1% hexane-insoluble, benzene-soluble acid, and 3.6% benzene-insoluble phenolic material.

Table II. Percentage Extractives from Douglas-Fir Bark Components
(Value based on oven-dry weight of material)

Sample no.	Bark component	Solvent: Hexane	Benzene	Ether	Ethanol	Hot water	Sum of 5 extractives
1a	Cork	5.84	2.50	19.00	11.80	2.21	41.34
1b	Bast fibers	3.07	1.12	1.38	10.72	1.64	17.93
2	Cork	8.09	2.26	8.17	11.36	1.60	31.48
3	Cork	5.60	0.88	5.55	11.10	...	...
4	Cork	4.67	1.13	13.26	16.65	...	...
5	Cork	4.86	1.80	23.35	11.33	...	...
6	Cork	5.93	2.02	18.88	11.93	...	...
7a	Cork	5.76	2.49	22.51	9.76	...	...
7b	Bast fibers	3.00	1.72	3.51	10.61	...	...
7c	Inner bark	1.04	0.28	0.26	7.89	...	...
8a	Cork	4.04	1.58	18.16	7.28	0.97	32.03
8b	Bast fibers	3.40	0.36	0.51	35.60	1.34	41.21
8c	Inner bark	0.97	0.38	0.81	27.23	2.84	32.23
9	Cork	7.19	2.64	15.62	9.81	1.22	36.48

Douglas-fir bark has been shown to contain about 30% of extractives. The principal extraneous components are waxes, tannin, dihydroquercetin, and carbohydrate matter (*11*) which are also present in the extraneous fraction of Douglas-fir cork. Table II gives the extractive content of the mechanically separated components prepared from the bark samples listed in Table I, while Table III shows the nature of the materials extracted with each solvent.

The analyses in Table II show that the cork from Douglas-fir bark is rich in extractives. In general, the total extractive content is approximately 40% of the weight of the cork. The extractive present in the greatest quantity is dihydroquercetin, the percentage of which varies from 5% in samples of cork from second-growth trees to 23% in cork from mature trees.

Table III. Nature of Douglas-Fir Bark Extractives

Solvent	Extractives
Hexane	Cream-colored wax
Benzene	Light brown wax
Ethyl ether	Dihydroquercetin
Ethanol	Tannin and phlobaphene
Hot water	Tanning and carbohydrate matter

Benzene Extract

The benzene extract from the cork was a hard, brown wax, which melted at 60 to 62°C. Twenty grams of the wax were saponified for 6 hours with 150 ml. of 1 *N* alcoholic potassium hydroxide and, after dilution with water and evaporation of the alcohol, the resultant soap solution was separated in accordance with the method outlined in Fig. 1.

The unsaponifiable portion, I, was completely soluble in hexane. Crystallization from acetone yielded lignoceryl alcohol, melting point 68 to 69°C. The mixed melting point of this compound with lignoceryl alcohol from the hexane-soluble wax was undepressed. The acetone filtrate from the lignoceryl alcohol crystals was evaporated to a small volume and placed in an icebox. White, needle-shaped crystals with a melting point

of 133 to 135°C. were obtained, which gave a positive Liebermann-Burchard test for sterols.

The hexane-soluble acid fraction, II, when recrystallized from acetone, melted at 72 to 74°C. and had a neutral equivalent of 363. A mixed melting point with lignoceric acid from the hexane wax was undepressed. Evaporation of the solvent did not yield additional products.

The benzene-soluble fraction of acids, III, comprised the largest portion of the wax. It was further separated into two fractions by dissolving the mixture in ethyl acetate and allowing precipitation to occur at 0°C. The precipitate was purified by resaponification with alcoholic potassium hydroxide and two recrystallizations from ethyl acetate. A white powder, IV, with a melting point of 79 to 81°C. and a neutral equivalent of 274, was obtained. When intimately mixed with the hydroxy palmitic acid, described later in the section on extractive-free cork, no depression in melting point was observed. Evaporation of the ethyl acetate filtrate from the hydroxy palmitic acid crystals gave a yellow residue, V, with a melting point of 40 to 45°C. and a neutral equivalent of 282. After acetylation with acetic anhydride and pyridine, an acetyl group determination indicated 13% acetyl. A positive test for unsaturation was obtained with permanganate, thus indicating that this product contains unsaturated, hydroxy acids. The benzene-insoluble, ether-soluble acid, VI, had a melting point of 45°C., a neutral equivalent of 263, and gave a positive test for unsaturation. It could not be crystalized from a variety of solvents and was not further characterized.

The acetone-soluble, ether-insoluble component, VII, was a reddish-brown, phlobaphene-like material. When an alcoholic solution of this material was treated with ferric chloride, a greenish-brown coloration was produced. The ultraviolet spectrum of this material is shown in Fig. 2.

The water-soluble, ethyl acetate-soluble fraction, VIII, of the wax was glycerol, boiling point 285°C.; its benzoate derivative had a melting point of 67 to 68°C. The aqueous fraction, insoluble in ethyl acetate, was neutralized and evaporated to dryness. A dark brown residue, IX, which decomposed at 250°C., was obtained. It was not further characterized.

Ether Extract

The ether extract from the wax-free cork was a cream-colored powder, melting at 234 to 236°C. Recrystallization from hot water gave long, white needles of dihydroquercetin, melting point 241 to 242°C.; its acetate derivative with acetic anhydride and pyridine had a melting point of 84 to 86°C. Approximately 93% of the ether extract from the wax-free cork of mature trees was recovered as pure dihydroquercetin.

Tannin

The dried alcohol extract from the wax-free, dihydroquercetin-free cork residue consisted primarily of tannin and a red amorphous phlobaphene. The latter was separated from the tannin through its insolubility in hot water. It had a methoxyl group content of 2.38% and gave a green coloration with ferric chloride solution.

Tannin analyses on air-dry, unextracted cork were carried out by the method of the American Leather Chemists Association (*1*), using an extraction time of 4.5 hours. Average results of analyses on cork sample

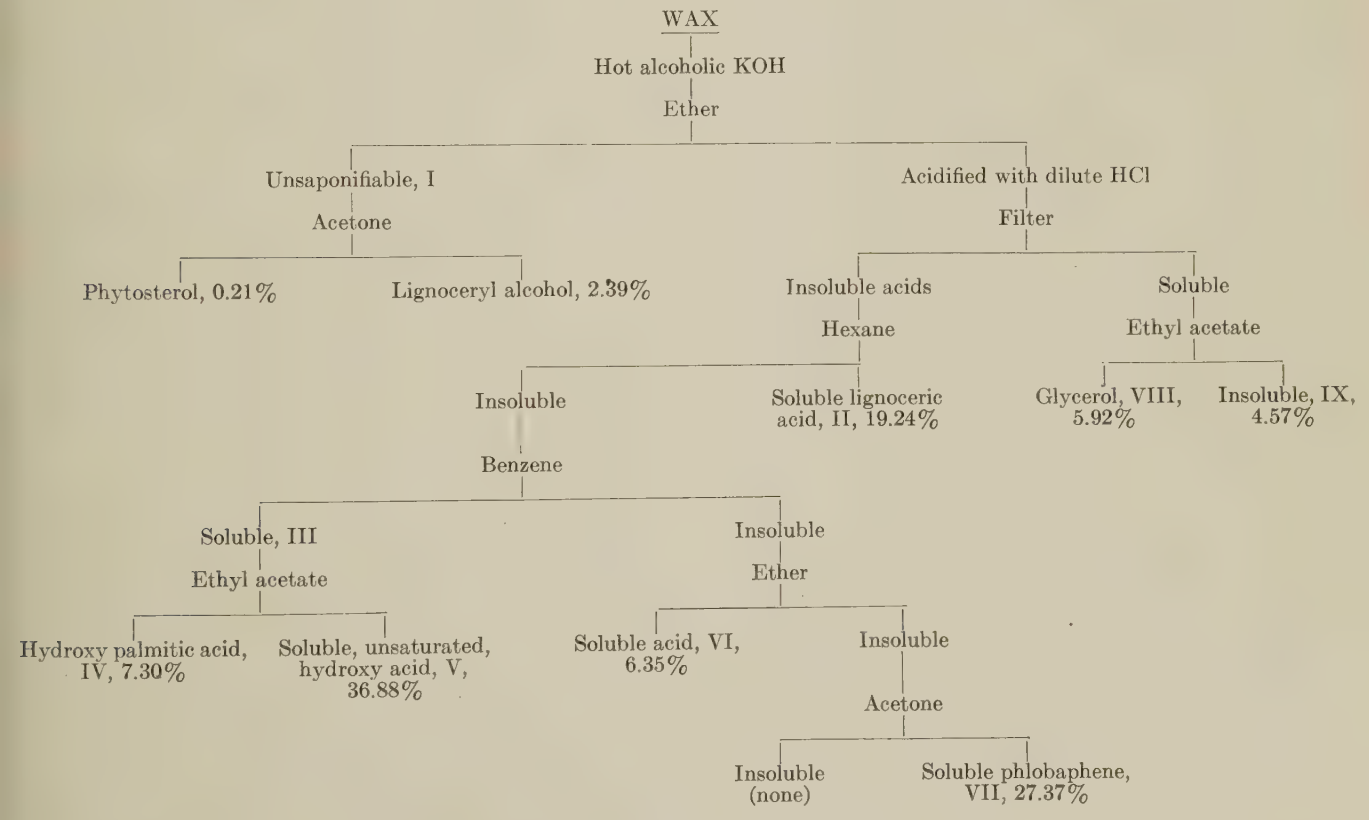

Fig. 1. Separation of components of benzene-soluble wax

(Percentages based on oven-dry weight of wax)

1a are shown in Table IV. The ratio of tannin to soluble solids was 0.786, which indicated a tannin extract of 78.6% purity.

Table IV. Percentage Tannin Content of Douglas Fir Cork
(Values based on oven-dry weight of cork)

Total solids	29.14
Soluble solids	26.70
Insoluble solids	2.44
Tannin	20.97
Soluble nontannins	5.83

The tannin solution was light yellow-orange in color. A sheepskin skiver tanned with the solution gave a light-tan-colored, well-plumped, pliable, leather product.

Since dihydroquercetin is soluble in hot water and combines with hide powder in the conventional tannin determination, it was thought desirable to analyze for tannin after the dihydroquercetin had been removed from this sample of cork. Accordingly, the cork was first exhaustively extracted with ether in a Soxhlet extractor, then air-dried, and re-extracted with hot water for 4.5 hours in the tannin extractor. The aqueous extract was then analyzed by the conventional procedures. The results, calculated on the oven-dry weight of the original unextracted cork sample, are given in Table V.

A comparison of the data in Tables IV and V indicates that the principal tanning action of an aqueous extract of Douglas-fir cork is due to the large amount of dihydroquercetin in the extract. An aqueous solution of pure dihydroquercetin gave a white leather product with sheepskin skivers. Since the leather appeared to be well tanned but quite brittle, pure dihydroquercetin apparently does not give a good leather product, unless mixed with tannin, in which case the tannin appears to act as a dispersant for the dihydroquercetin. Pure dihydroquercetin crystallizes very quickly from hot water on cooling the solution, but the presence of a small amount of extraneous tannin markedly retards the crystallization.

A tannin-free, aqueous extract from the cork was hydrolyzed for 6 hours with 4% sulphuric acid solution, then neutralized with barium carbonate, filtered, and evaporated to a sirup for the determination of the nature of the sugars present by paper partition chromatography according to the procedure of Wise (*16*). Upon development with silver nitrate solution, two spots of about equal size and intensity were obtained. They corresponded to glucose and galactose. Spots corresponding to mannose and pentose sugars were absent. Unfortunately, the partition procedure does not give complete resolution to mixtures of glucose and galactose, so a quantitative estimation could not be made. The presence of galactose was confirmed by a mild oxidation with 25% nitric acid; a small amount of mucic acid was isolated and recrystallized to a melting point of 212 to 214°C.

Table V. Percentage Tannin Content of Wax-Free, Dihydroquercetin-Free Cork
(Values based on oven-dry weight of original unextracted cork)

Total solids	8.69
Soluble solids	7.57
Insoluble solids	1.12
Tannin	2.68
Soluble nontannin	4.89
Reducing sugar	2.01
Reducing sugar after hydrolysis	3.23

EXTRACTIVE CONTENT OF MEDITERRANEAN OAK CORK

One of the principal objections cited against the commerical use of Douglas-fir cork in crown seals is its high extractive content. Mediterranean cork, the material now in use, is boiled in water prior to processing. Since complete data on the extractive content of Mediterranean oak cork are not available, commercial samples were obtained and analyzed. The results of these analyses are shown in Table VI. The extractive content is much lower than that of unextracted Douglas-fir cork, but the comparison becomes more favorable after the latter has been leached with hot water. Hot-water extracted Douglas-fir cork contains, in the main, more water-insoluble waxes and phlobaphene than Mediterranean oak cork.

CHEMICAL ANALYSIS OF DOUGLAS-FIR EXTRACTIVE-FREE CORK

Six hundred grams of 20 to 30-mesh, air-dry, sample 1a Douglas-fir cork were successively extracted with a constant boiling alcohol-benzene mixture, and alcohol in a large, glass, Soxhlet-type extractor. The extractions were continued until no more extractives were removed. Following this, the cork particles were air-dried to remove absorbed solvent and the water-soluble extractives were removed by placing 75-gram portions of the solvent-extracted cork residue in 1-liter Erlenmeyer flasks, and treated with a total of 2.5 liters of hot water in three equal portions for a total of 6 hours. The total yield of extractives was 41.4%; complete extraction was indicated. The extractive-free cork was air-dried and stored for subsequent analysis. Samples of Mediterranean oak cork were extracted by the same procedure.

Table VI. Percentage Extractive Contents of Mediterranean Oak Cork and Hot-Water Leached Douglas-Fir Cork
(Values based on oven-dry weight of material)

Solvent	*Commercial cork, 15–30 mesh*[a]	*Virgin cork, hard external*[b]	*Stopper waste*[b]	*Typical ground cork, 2–5 mesh*[b]	*Douglas-fir cork, sample 1a leached with hot water*
Hexane	5.10	4.05	3.22	2.75	7.06
Benzene	1.29	2.30	2.20	1.38	2.83
Ethyl ether	0.41	0.52	0.53	0.42	1.90
Ethanol	4.91	3.29	3.13	2.87	6.57
Hot water	4.85	2.83	3.20	2.16	1.44
Sum of 5 extractives	16.56	12.99	12.28	9.58	19.80

[a] Crown Cork and Seal Co.
[b] Armstrong Cork Co.

A standard lignin analysis with 72% sulphuric acid applied to the extractive-free Douglas-fir cork gave 84.27% insoluble matter, a light-brown powder of which 71.30% dissolved in a 1% sodium hydroxide solution at room temperature after 24 hours. Upon acidification of the alkaline solution, a brown floc was obtained, a part of which was soluble in ethyl ether. The hydrolyzate from the treatment of the cork with 72% sulphuric acid was analyzed for reducing sugar.

The yield of reducing sugar indicated that at least 11% of the extractive-free cork was carbohydrate matter.

A 10-gram sample of extractive-free Douglas-fir cork was refluxed with 150 ml. of 3% sulphuric acid for 8 hours. The cork residue was filtered off and the treatment was repeated. The filtrates when neutralized with barium carbonate, filtered, and analyzed for reducing sugar, indicated a 10.67% yield of reducing sugar at the end of 8 hours, and 11.13% at the end of 16 hours.

A 5-gram sample of the extractive-free Douglas-fir cork was refluxed with 500 ml. of 0.5 *N* alcoholic KOH, in three portions, for a total of 9 hours. The cork residue was washed with hot water until the filtrate was neutral, then with dilute acetic acid, acetone, and ether, and dried in a vacuum oven at 55°C. to constant weight. This residue, which consisted of individual cells, amounted to 14.37% and indicated that 85.63% of the extractive-free cork was soluble in alkalies.

One of the experimental methods used in the isolation of lignin from wood is by treatment with dioxane at 100°C. in the presence of hydrogen chloride as a catalyst (*6*). Twenty-five grams of the extractive-free Douglas-fir cork were extracted with 600 ml. of dioxane containing 0.4% by weight of hydrogen chloride for 20 hours in a glass Soxhlet extractor. In this way, 82.46% of the extractive-free cork was removed. The dioxane-HCl extract was poured into 4 liters of cold water and the grayish-brown precipitate was filtered off on a suction filter. It was washed with water until the filtrate was neutral, and then it was dried in a vacuum oven for 8 hours at 55°C. The dry precipitate, which was dark brown and horny in appearance, was soluble in warm 5% sodium hydroxide solution, but insoluble in neutral organic solvents, dilute mineral acids, and hot water. The material, after solution in sodium hydroxide, was re-precipitated with dilute hydrochloric acid. A portion of the precipitate was found to be soluble in ethanol, which indicated that the dioxane-HCl extract was a mixture of materials.

The cork residue remaining from the dioxane-HCl treatment was reddish in color and, under examination with a microscope proved to consist of individual cork cells. The cork residue was washed with water, acetone, and ether on a suction filter and air-dried. The standard 72% sulphuric acid lignin determination showed 77.5% to be soluble. The hydrolyzate gave a test for reducing sugar and indicated that 12.81% of the extractive-free cork was carbohydrate matter.

It was evident from these orienting experiments that the extractive-free cork contained two fractions. One was a carbohydrate cellular material, unattacked by dioxane-HCl or alkali but mostly soluble in 72% sulphuric acid. The other, amounting to approximately 85% of the extractive-free cork, was alkali-soluble, and apparently functioned to bind the cellular material together.

SEPARATION OF THE COMPONENTS OF EXTRACTIVE-FREE CORK

A series of orienting experiments indicated that the material removed by dioxane-HCl or alcoholic potassium hydroxide solution from the extractive-free cork was related to the benzene-soluble, hexane-insoluble

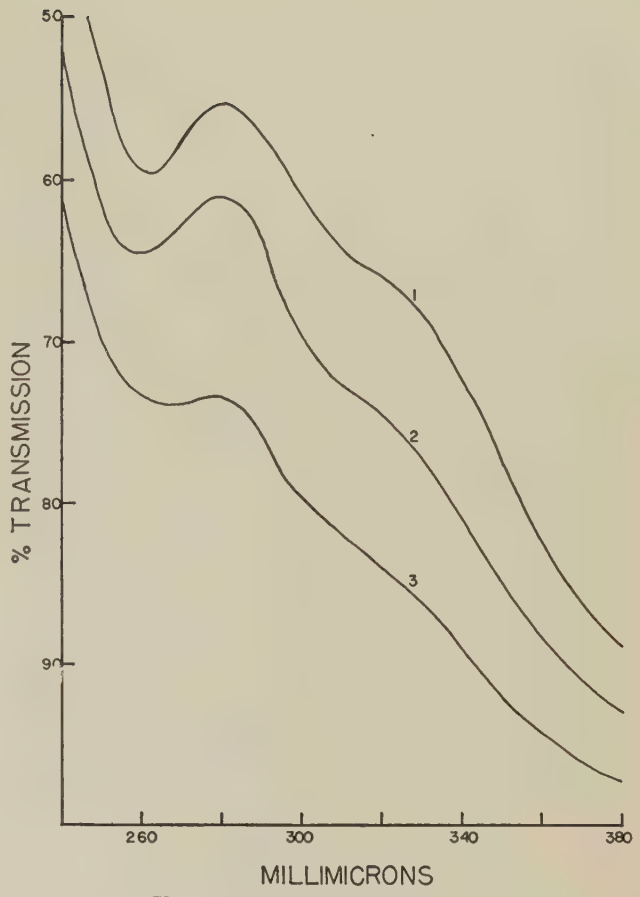

Fig. 2. Ultraviolet spectra of bark components

(1) Ether-insoluble phenolic acid from cork, 15 mg./l. (2) Ether-insoluble fraction from hexane-insoluble wax, 14 mg./l. (3) Etherinsoluble phenolic acid from bast fibers, 12.5 mg./l.

wax discussed in the section on extractives. Accordingly, the schematic diagram shown in Fig. 3 for the isolation of the components of the extractive-free cork is similar to that shown in Fig. 1 for the separation of the components of benzene-soluble wax.

Two 100-gram portions of extractive-free Douglas-fir cork were each refluxed with a total of 2.0 liters of 1.2 *N* alcoholic potassium hydroxide in 500-ml. portions for a total time of 8 hours, and then filtered.

The combined cork residues were washed with hot water on a suction filter, then with dilute hydrochloric acid, acetone, and ether. All filtrates and washings were combined, sufficient hydrochloric acid was added to reduce the solution to a pH of 11.2, and the resultant solution was heated in a hot-water bath to remove alcohol, acetone, and ether. This aqueous soap solution was extracted with ethyl ether in a separatory funnel to remove unsaponifiable compounds, I.

The soap solution was then poured into 1.5 liters of 5 *N* hydrochloric acid to precipitate the water-insoluble acidic materials. These were filtered off with suction, washed with water until the washings were neutral, and air-dried at room temperature. The dried material was then placed in a paper thimble and successively extracted with hexane, benzene, and ethyl ether in a glass Soxhlet extractor. The remaining ether-insoluble residue was air-dried; it amounted to 42.28% of the extractive-free cork.

Hexane-Soluble Component, II

The material soluble in hexane was resaponified with

alcohol potassium hydroxide, recrystallized twice from ethyl acetate and finally from hexane. A white microcrystalline compound was obtained which was soluble in ethyl ether and ethanol, sparingly soluble in acetone, ethyl acetate, benzene, and hot hexane, but insoluble in water. It had a melting point of 78 to 79°C., a neutral equivalent of 218.6, and a molecular weight of 215, by the Rast camphor method. With acetic anhydride and pyridine, it gave an acetate that melted at 54°C., contained 16.0% acetyl, and had a neutral equivalent of 256. These properties correspond to a hydroxydodecanoic acid, $C_{12}H_{24}O_3$; with a neutral equivalent of 216.3 and a molecular weight of 216.3. Its acetate derivative contains 16.6% acetyl.

Fusion of the acid with potassium hydroxide at 340°C. (*5*) produced undecanoic acid, $C_{11}H_{21}O_4$, melting point 108 to 110°C., neutral equivalent 111.6, and molecular weight 212. Synthetic undecanoic acid melts at 111°C. (*12*), has a neutral equivalent of 108.2, and a molecular weight of 216.4. Fusion under the above conditions causes cleavage of a hydroxy acid at the carbon atom which is connected to the hydroxyl group. This showed the hexane-soluble component to be 11-hydroxy lauric acid. A search of the literature indicated that this is the first reported isolation of this acid from either natural or synthetic sources. Previously prepared hydroxy lauric acids are the 2-, 3-, 4-, and 12-hydroxy acids (*15*), of which only the 12-hydroxy acid is known to occur in nature (*12*).

Benzene-Soluble Component, III

The benzene-soluble fraction was dissolved in hot ethyl acetate, and then placed in an icebox. A light tan microcrystalline material separated; this was resaponified and then twice recrystallized from ethyl acetate.

The final product, IV, was a white, microcrystalline powder with a melting point of 81 to 82°C.; soluble in benzene, ethyl ether, ethanol, acetone, and methanol; insoluble in water; and with a neutral equivalent of 277.0. Acetylation with acetic anhydride and pyridine yielded an acetate derivative with a melting point of 56 to 57°C. and a 12.9% acetyl content. The calculated neutral equivalent for a hydroxy palmitic acid, $C_{16}H_{32}O_3$, is 272.4; the acetate derivative has 13.7% acetyl. Since oxidation with alkaline permanganate at 50°C. did not decrease the neutral equivalent, the hydroxyl group on this acid was not terminal. When the acid was heated above its melting point, or was in contact with mineral acids, the neutral equivalent increased, and the melting point decreased as much as 40°C. which is typical of lactone or estiolide formation. No depression in melting point was observed when the acid was intimately mixed with the

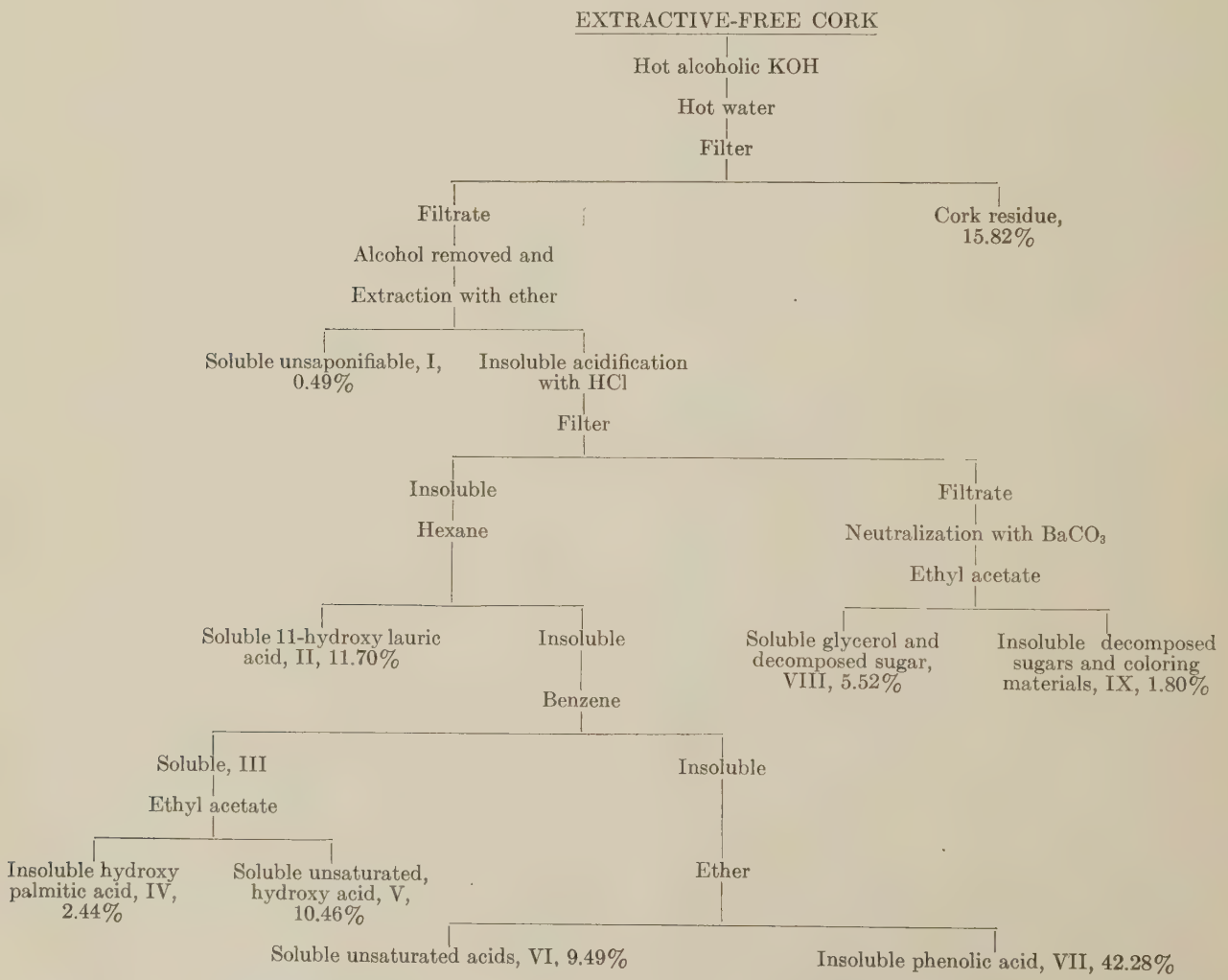

Fig. 3. Separation of components of extractive-free cork by saponification with alcoholic KOH

(Percentages based on oven-dry weight of extractive-free cork)

hydroxy palmitic acid obtained by a like process from the benzene-soluble wax (Fig. 1).

The ethyl acetate solution from the separation of the hydroxy palmitic acid was evaporated to dryness, and a yellow-orange solid with a melting point of 48 to 49°C., was obtained as a residue. The solid was resaponified, the solution acidified, the recovered material dissolved in acetone and reprecipitated by pouring into water. No organic solvent was found from which crystallization would take place. The material had a neutral equivalent of 278, decolorized permanganate and bromine solutions, and formed an acetate with 13% acetyl content. This indicated that it was a mono hydroxy hexadecenoic acid.

Ethyl Ether-Soluble Component, VI

The acid fraction, insoluble in benzene but soluble in ethyl ether, was dissolved in ethyl acetate. A small amount, 0.35% of the extractive-free cork, was precipitated as a light tan powder which, when recrystallized from ethyl acetate, had a melting point of 92 to 95°C. and a neutral equivalent of 382. It was not further characterized because of the small amount available.

The ethyl acetate filtrate was evaporated and a brown residue with a melting point of 48 to 51°C. and a neutral equivalent of 245.6, was obtained. It was noncrystallizable and gave positive tests for unsaturation with permanganate and bromine.

Phenolic Acid, VII

The largest cork component was the residue from the ether extraction. When first obtained, it was soluble in acetone but, after drying, it was reddish-brown in color and not appreciably soluble in neutral organic solvents. It was soluble in alkaline solutions but insoluble in water. The material contained 4.33% methoxyl groups and, like the phlobaphene material obtained from the saponification of the benzene-soluble wax (Fig. 1), gave a greenish-brown coloration with ferric chloride solution. A similar product was obtained by Kiefer when the bast fibers in Douglas-fir bark were treated with aqueous caustic solutions (*9*). He obtained a phenolic acid material with 4.34% methoxyl groups, 4.7% carboxyl groups, 14.23% phenolic hydroxyl groups, and 7.43% alcoholic hydroxyl groups. The ultraviolet spectra are shown in Fig. 2. On the basis of the ultraviolet spectra, physical properties, and methoxyl content, the phlobaphene from the wax and the phenolic acid from the bast fibers and cork are similar in nature. These materials possess different properties than the lignin in either hardwoods or softwoods.

Water-Soluble Components

The water-soluble fraction from the saponification of extractive-free cork contained chiefly glycerol and carbohydrate degradation products. The acid filtrate, when neutralized with barium carbonate and extracted with ethyl acetate, gave a light-brown, viscous liquid which, upon distillation with reduced pressure, produced glycerol (boiling point 280 to 285°C., n_D^{25} 1.4729, benzoate derivative with melting point of 69 to 70°C.) amounting to 4.6% of the weight of the extractive-free cork. The water solution from the glycerol separation yielded a sticky residue with a caramel-like odor on evaporation. A positive test for carbohydrate matter was obtained with phloroglucinol and hydrochloric acid.

ISOLATION OF HYDROXY ACID-PHENOLIC ACID COMPLEX

The question of how the hydroxy acids, phenolic acid, and glycerol are chemically associated in the cork was next investigated. For this purpose, extractive-free Douglas-fir cork was treated with a 2% aqueous solution of potassium hydroxide at room temperature for 20 hours. The insoluble residue was removed by filtration, and the filtrate acidified. A voluminous grayish-brown precipitate was obtained which, after being washed and air-dried, was extracted successively with hexane, benzene, and ethyl ether. The amount of each fraction is shown in Table VII.

The hexane-soluble fraction was a cream-colored wax with a melting point of 50 to 55°C. and a neutral equivalent of 410. Saponification with 0.5 *N* alcoholic potassium hydroxide for 6 hours gave only 11-hydroxy lauric acid, melting point 76 to 78°C., neutral equivalent of 223.6, and no depression in mixed melting point with the acid isolated previously from extractive-free cork. This indicated that part of the hydroxy acids is present in the cork in an etholide-type linkage. Saponification of an etholide yields only salts of the hydroxy acids, showing that it is a linear ester in which a hydroxy acid functions as both acid and alcohol (*3*).

Table VII. Percentage Products Obtained by the Treatment of Extractive-Free Cork with Aqueous 2% Potassium Hydroxide at 20°C.

(Values based on oven-dry weight of extractive-free cork)

Alkali-insoluble cork residue	21.33
Soluble in alkali	78.67
Hexane-soluble	4.42
Benzene-soluble	10.63
Ethyl ether-soluble	21.96
Ethyl ether-insoluble	34.10
Water-soluble	7.56

The benzene-soluble fraction was a yellow-brown wax with a melting point of 64°C. and a neutral equivalent of approximately 470. Saponification of this material yielded 45.0% 11-hydroxy lauric acid, 37.3% benzene-soluble acids, 11.1% ethyl ether-soluble acids, and 3.6% ether-insoluble material. The acids were identical with the acids of corresponding solubility previously isolated and characterized.

The ethyl ether-soluble fraction was a dark brown waxy solid which softened at 70°C. and appeared to be relatively homogeneous. It was saponified with alcoholic potassium hydroxide and the components separated in accordance with the procedure shown in Fig. 3. The product yields are shown in Table VIII. The cork phenolic acid fraction was similar in physical properties to that previously isolated, and had a methoxyl content of 4.29%. The isolation of substances identical with those previously isolated indicated that the ether-soluble fraction obtained by aqueous alkaline treatment of cork is a phenolic acid-hydroxy acid ester.

The water-soluble fraction contained glycerol and some degraded carbohydrate matter.

The ether-insoluble fraction had a methoxyl content of 4.3% and its ultraviolet spectrum was similar to the cork phenolic acid previously isolated (Fig. 2).

ANALYSIS OF EXTRACTIVE-FREE MEDITERRANEAN OAK CORK

In order to compare Mediterranean oak cork with Douglas-fir cork, the former was treated with alcoholic and aqueous potassium hydroxide solutions in the same way as the latter. The products isolated are shown in Table IX.

Upon recrystallization from a large volume of hot hexane, the hexane-soluble acid was obtained as a white microcrystalline powder with a melting point of 84 to 86°C. and a neutral equivalent of 377. These properties agree with those of phellonic acid described in another publication (*17*). The benzene-soluble acid gave a positive test for unsaturation, melted at 36 to 39°C., and had a neutral equivalent of 302. These properties are comparable to those of suberinic acid (*13*) which is said to be isomeric with ricinoleic acid. The ether-soluble acids were unsaturated and could be separated into several fractions by crystallization from methanol or ethyl acetate. Glycerol was detected in the water-soluble fraction. The ether-insoluble fraction was dark brown in color and partially soluble in acetone, like the phenolic acid from Douglas-fir cork.

SUMMARY OF RESULTS

This study indicates that the extractive content of Douglas-fir cork may range from 31 to over 41% of the dry weight of the cork. The chief extractive components are dihydroquercetin, waxes, tannin, and carbohydrate matter. Some cork may contain as much as 22% of dihydroquercetin. This flavanone is a tanning agent and is determined as tannin in the conventional hide powder tannin procedure. The soluble carbohydrate fraction contains glucose and galactose.

Table VIII. Percentage Components of the Ether-Soluble Fraction Obtained from Aqueous Alkaline Extraction of Douglas-Fir Cork at 20°C.

(Values based on oven-dry weight of fraction)

Unsaponifiable	0.004
11-hydroxy lauric acid	7.31
Hydroxy palmitic acid	13.02
Benzene-soluble, unsaturated hydroxy acid	4.42
Ether-soluble unsaturated acid	12.57
Ether-insoluble phenolic acid	62.46

The study shows that the wax component, insoluble in aliphatic hydrocarbons but soluble in benzene and chlorinated hydrocarbon type solvents, is composed of lignoceric acid, hydroxy palmitic acid, unsaturated hydroxy acids, lignoceryl alcohol, phytosterol, glycerol, and a phlobaphenelike material. It has a marked similarity to the material which cements the cork cells together and appears to be the precursor of this substance.

Extractive-free cork is composed of two fractions. One fraction, 82 to 85% of the dry weight of the extractive-free cork, is soluble in alkalies or dioxane-hydrogen chloride reagent. The other fraction, about 15% of the weight of the extractive-free cork, is a carbohydrate, thin-walled, cellular material. The alkali-soluble fraction is composed of 11-hydroxy lauric acid, hydroxy palmitic acid, unsaturated hydroxy acids, glycerol, and an amorphous dark-colored phenolic acid material. The assumption that the latter is actually lignin, such as is found in wood, is not borne out by chemical analysis.

Table IX. Percentage Components from Extractive-Free Mediterranean Oak Cork by Saponification with Alcoholic KOH

(Values based on oven-dry weight of extractive-free cork)

Hexane-soluble acid (hydroxy, lignoceric acid)	13.49
Benzene-soluble unsaturated acid	19.08
Ether-soluble acid	8.35
Water-soluble products (glycerol and carbohydrate matter)	9.13
Ether-insoluble fraction	27.25
Insoluble cork residue	21.18

In Douglas-fir cork, the hydroxy acids are not only esterified to the phenolic acid but also to each other in an etholide-type linkage. The common concept of cellulose-fatty acid linkages in the suberization of plant tissues was not confirmed by the findings of this study and is open to question. A hydroxy acid-phenolic acid complex also was isolated from the cork.

A comparison of Douglas-fir cork with Mediterranean oak cork showed that they are quite similar chemically, with the exception of the higher extractive content of the former and the higher molecular weight of the acids in the latter.

It appears that in nature the fatty materials, dihydroquercetin and tannin, move through the rays of the inner bark out to the cork cambium. Oxidation then apparently takes place, for the hydroxy acids of the cork have shorter chains and a much higher oxygen content than the acids present in the extractives.

The high dihydroquercetin content of the cork may indicate that it is a by-product of metabolism which gradually accumulates in the cork as the age of the cork increases.

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Reactions with Homogenized Sprucewood

F. E. BRAUNS and HEINZ SEILER

Since sprucewood is considered to be a heterogeneous product an aqueous colloidal solution was prepared in which the wood fiber structure was completely destroyed. When the extraction of the homogenized wood, regenerated from the solution and obtained as an extremely fine powder, failed to give additional native lignin, the colloidal wood was methylated with diazomethane and with dimethyl sulphate. From these methylated products also no lignin could be extracted by indifferent solvents, indicating that the lignin is present in wood either in a highly condensed state or in a chemical combination with other wood constituents. The ultraviolet and infrared absorption curves of sprucewood are shown.

Sprucewood is considered to be an unhomogeneous material. This can be seen from a cross section of a wood fiber which shows that the cellulose fibers are embedded in or surrounded by the middle lamella. The middle lamella consists chiefly of lignin, whereas the center part of the fiber is made up mainly of cellulose. The unhomogeneity of wood is also shown when the carbohydrates are removed by chemical means leaving a coherent lignin net. If wood were a homogeneous material, then, on removal of the carbohydrates, the lignin would be left as a fine powder which would no longer show the morphological structure of the wood fiber, as does the lignin which has been isolated from sawdust or a coarse wood meal.

When sprucewood and also other woods are extracted with indifferent solvents, such as dioxane or ethyl alcohol, without the use of a catalyst, a small portion of the lignin can be extracted. This amounts to about 8 to 10% of the lignin or 2 to 3% of the wood in the case of black spruce, but the yield of isolated native lignin seems to change with the season in which the tree is cut. An investigation of this relationship is now under way. The yield is practically the same whether a coarse sawdust or a very fine wood flour is used —in other words, the particle size of the wood to be extracted seems to have no influence upon the yield of native lignin. This may be due to one of two reasons: Either the remainder of the lignin is in a chemical combination with or is firmly adsorbed to another component of the wood, or the lignin is present in a free but highly polymerized or condensed state which renders it insoluble.

Recently Nord and co-workers (*1*) have shown that, when different lignified materials, after being exhaustively extracted with alcohol, are exposed to the action of wood-destroying fungi of the brown-rot type (which decompose the carbohydrates), more lignin is "liberated" and can be extracted by different solvents. They found that this liberated native lignin has the same composition and properties as isolated native lignin and, from this, they concluded that the remainder of the lignin is identical with isolated native lignin. In this way they confirmed an earlier claim by Brauns (*2*) that the residual lignin behaves chemically very similarly to isolated native lignin. From his results, Nord drew the conclusion that the liberated native lignin is present in the plant in an uncombined state and is set free mechanically by the decomposition of the carbohydrates. This conclusion will be justified, however, only when it can be proved that the enzymatic action of the fungi does not split a possible lignin-carbohydrate linkage.

If lignin is present in wood in a free state but cannot be extracted because it is *mechanically* hindered by encasement by or absorption on other wood components, it should be possible, by complete mechanical destruction of the wood fiber, to liberate at least a part of the lignin and to extract it. The work described here deals with such an endeavor and, because the wood has been obtained in such an extremely fine distribution, reactions can be carried out under much more homogeneous conditions than in the case of sawdust or wood flour.

When sprucewood sawdust, which has been completely freed of soluble native lignin by exhaustive extraction with alcohol and benzene-alcohol, is beaten in a water suspension in an experimental pulp beater, the wood is soon hydrated and a part is colloidally dissolved giving a slightly bluish solution similar to that of watered milk. The solution gives a very strong purple color reaction with phloroglucinol-hydrochloric acid and shows an ultraviolet absorption curve (Fig. 1) almost identical with that of isolated native spruce lignin. It reduces Fehling solution slightly. When it is centrifuged at 20,000 r.p.m., filtered through a Schleicher and Schüll filter no. 588, and concentrated under reduced pressure at a water bath temperature of not above 40°C., the solution becomes somewhat viscous and turbid and, finally, a slimy, voluminous, flocculent precipitate separates. An attempt to prepare a film by spreading the solution on a mercury surface and allowing the water to evaporate slowly in the air resulted only in the formation of a brittle horny powder. However, during the concentration of solution under reduced pressure, a film formed in the upper part of the flask and, on drying, it readily peeled off. This film is transparent but slightly yellowish to light brown in color because of the presence of iron originating from the beater. This color can be removed by treating the film for a few hours with a 2% oxalic acid solution. On treatment with alkaline hydrogen peroxide solution, an almost colorless film is obtained. When treated with phloroglucinol-hydrochloric acid, the film becomes bright purple in color resembling a deeply colored cellophane film. The film is flexible but somewhat brittle. The infrared absorption of this wood film is shown in Fig. 2, together with that of a viscose cellophane film (Fig. 3). Because the cellophane may still contain some plasticizer, in spite of prolonged extraction with water and alcohol, attempts are in prog-

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ress to prepare a film from a lignin-free spruce holocellulose. The wood film has the same hydrochloric acid lignin content as the original sprucewood and the lignin has a methoxyl content of 14%.

The colloidal or homogenized sprucewood which separates on concentration of the solution contains about 1% iron which causes its brownish color, but this can be removed by means of electrodialysis during which it is deposited on the dialysis membrane at the cathode side. After removal of the iron, the colloidal wood shows a normal wood flour color.

The regenerated wood is completely soluble in Schweizer reagent forming a slightly greenish-blue solution. The centrifuged cuprammonium hydroxide solution, containing 2% dissolved wood, has a relative viscosity of 5.5. This low viscosity, as compared with that of cellulose, indicates that the components of the homogenized wood are present in a relatively low molecular state. From the solution, the wood can be regenerated either as a powder, a thread, or a film (the last two are very brittle) by means of hydrochloric acid or other precipitant in a way similar to that used in the regeneration of cellulose from a cuprammonium hydroxide solution. The homogenized wood is soluble in cuprammonium hydroxide only in a freshly prepared, moist state. After it has been dehydrated it is no longer soluble, even on prolonged standing in the reagent.

The wood regenerated from the cuprammonium hydroxide solution has a methoxyl content of 5 to 6%. When this solution is allowed to stand for several weeks, the methoxyl and lignin contents of the regenerated wood seem to increase, probably because of a degradation of some carbohydrates to water-soluble products. The regenerated wood is free of nitrogen.

On drying of the water-moist homogenized wood in the open air, the wood shrinks and becomes very hard with a lustrous surface. By careful dehydration, the homogenized wood is obtained as a very fine powder which no longer shows the morphological structure of the wood fiber and is no longer soluble in Schweizer reagent. This wood powder has the color of the original material; it gives a very intense color reaction with phloroglucinol-hydrochloric acid. The composition of the wood is unchanged indicating that the fiber as a whole has been dissolved and not only certain layers, in which case it would be logical to expect that the composition of the wood would be changed. The infrared absorption of the homogenized wood has been determined in Nujol and in perfluorokerosene (Fig. 4) and is compared with that of powdered cellulose (Fig. 5) in the same distribution media. The comparison of the infrared curves of the wood film and the homogenized wood shows that they are almost identical.

The fact that, on treatment of the colloidal wood and of the wood regenerated from the cuprammonium hydroxide solution with the different solvents used in the isolation of native lignin, no additional lignin can be extracted indicates that the lignin in sprucewood is present in a state which prevents its dissolution in spite of the fact that it was originally in a colloidal aqueous solution. This means that it is either chemically combined with or firmly adsorbed by some other wood components or it is present in a highly polymerized or condensed form and is, therefore, insoluble

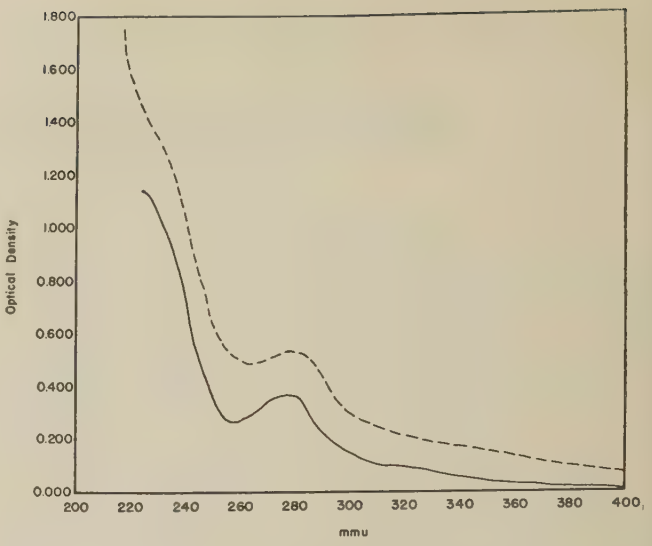

Fig. 1. Ultraviolet absorption spectra of - - - - colloidal spruce wood in water; — — native spruce lignin in dioxane

in organic solvents. In this connection, the question arises as to the boundary line between chemical combination and physical adsorption—in other words, where does adsorption end and chemical combination begin? If lignin and other wood constituents (chiefly carbohydrates) are present in the wood as a mechanical mixture and the lignin is in a state in which it is insoluble in lignin solvents, then it must be in a highly polymerized or condensed state. If the lignin is in a chemical combination with carbohydrates, then it may go into solution as a lignin-carbohydrate complex, as seems to be the case in cuprammonium hydroxide solution, and its extraction from wood is possible only after a cleavage of the linkage. If the lignin is adsorbed on carbohydrates such an adsorption is possible only through the reactive groups of the various wood components. These groups are present in the carbohydrates as primary and secondary hydroxyl groups with, probably, a very minute amount of aldehyde groups; in the uronic acids as carboxyl groups; and in the lignin as various types of aliphatic hydroxyl groups, phenolic hydroxyl groups and, probably, carbonyl groups and aliphatic double bonds, the presence of which has not yet been definitely proved. By covering the hydroxyl groups in the colloidal wood by either acetyl or methyl groups under conditions which will prevent any hydrolysis of a lignin-carbohydrate linkage, it should be possible to weaken or even eliminate the adsorptive power of these groups to such an extent that a mutual adsorption of the wood components is no longer possible. Under these conditions, it should be possible to extract the lignin (particularly since methylated lignins are more readily soluble in organic solvents than are unmethylated lignins) unless, as mentioned before, it is present in a highly polymerized or condensed state in which case methylation would have no effect on the solubility.

In preliminary experiments, homogenized sprucewood, which had not been dehydrated, was methylated with diazomethane in methanol-dioxane suspension. The initial reaction was very rapid but gradually slowed down and the mixture remained yellow for several days. The wood was then extracted successively with methanol, dioxane, ether, benzene, and petroleum

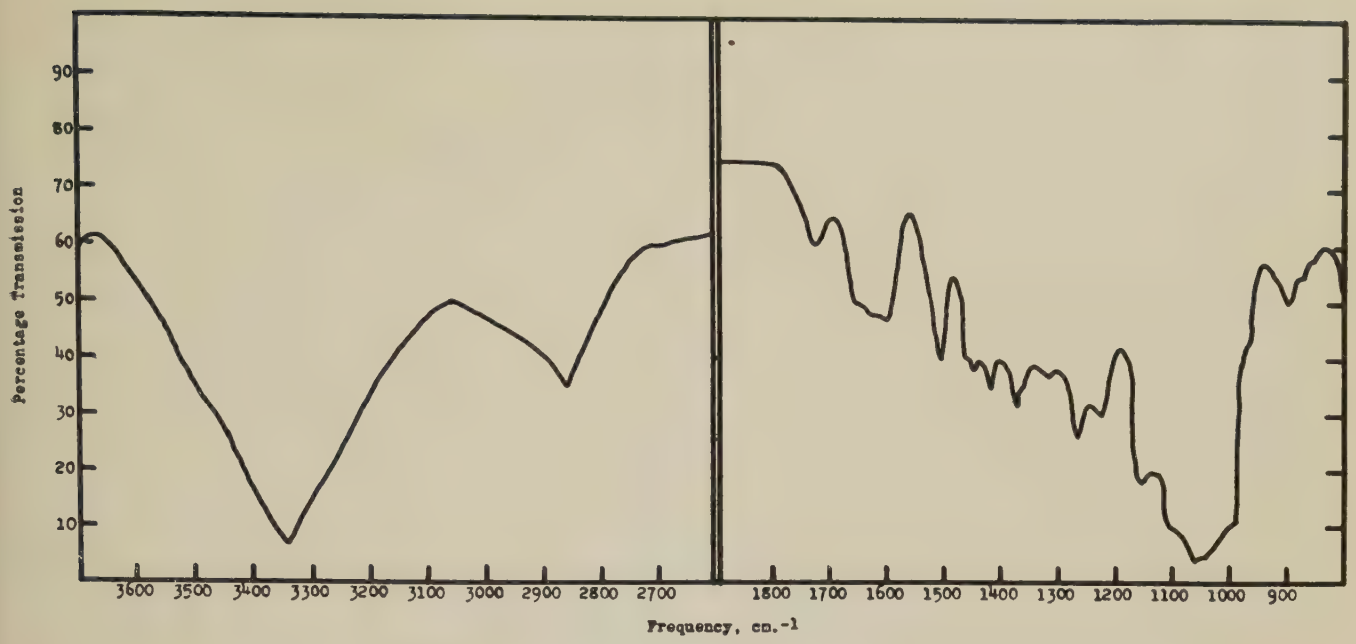

Fig. 2. Infrared absorption spectrum of wood film

ether and was obtained as a white powder. It gave only a very faint color reaction with phloroglucinol-hydrochloric acid. It had a methoxyl content of 16.7% (a value which is reached with wood meal only after methylation for 2 to 3 months), from which it is calculated that about 33% of the free hydroxyl groups in the wood were methylated. Its lignin content was 25.4% indicating that no change has occurred when the increase in molecular weight, caused by the introduction of methoxyl groups, is taken into consideration. The solutions obtained from the extractions during the dehydration of the methylated wood with the alcohol and dioxane did not contain any lignin.

Since the methylation with diazomethane had no effect upon the solubility of the protolignin in organic solvents, a sample of the diazomethane-premethylated wood was methylated further in an aqueous suspension by simultaneous addition of dimethyl sulphate and sodium hydroxide at room temperature. After three methylations, the wood was isolated again and extracted with various lignin solvents, but no methylated lignin was dissolved. Several years ago the observation was made that methylated sprucewood meal with a methoxyl content of 38.8% forms quite a viscous, partly gelatinous solution in resorcinol dimethyl ether. When the methylated homogenized sprucewood is extracted with this solvent, a part is dissolved and the wood is recovered as a white powder by pouring the clear colorless solution into ether. The recovered material has a methoxyl content of 38.7%—the same value as that obtained by Freudenberg and Urban (*3*). The undissolved material has a methoxyl content of only 30%, indicating that it is not yet completely methylated. A lignin determination of this material has not yet been made. The fact that no lignin can be extracted from the fully methylated homogenized sprucewood again may be taken as further indication that the lignin is chemically combined with other wood

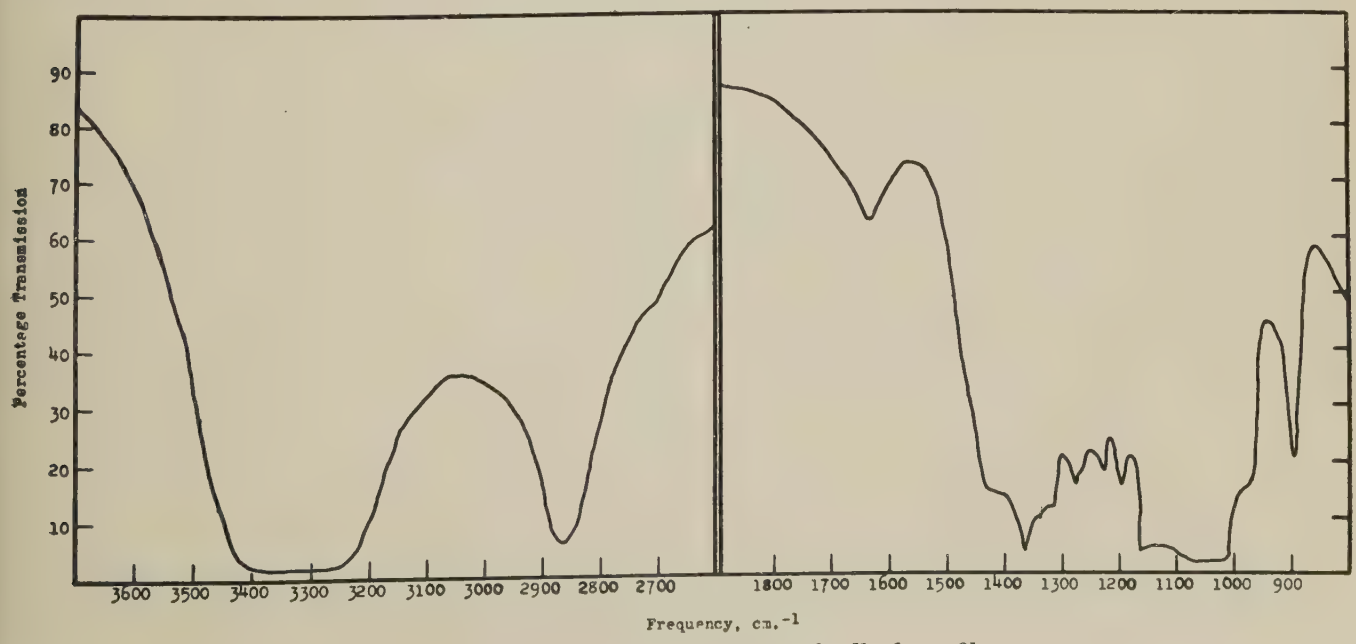

Fig. 3. Infrared absorption spectrum of cellophane film

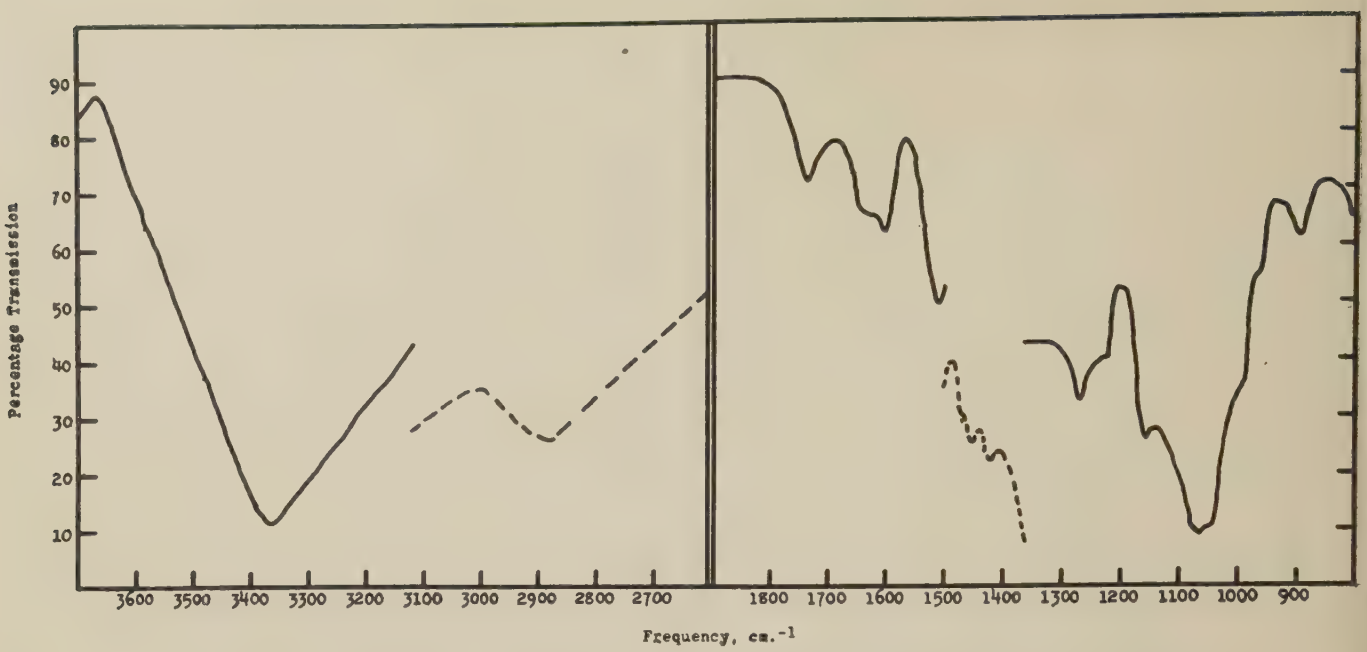

Fig. 4. Infrared absorption spectrum of homogenized sprucewood in Nujol and perfluorokerosene

constitutents. Similar experiments with other wood species are in progress.

PREPARATION OF COLLOIDAL SPRUCEWOOD

About 500 grams sprucewood sawdust, from a freshly cut tree and which has been exhaustively extracted with ethyl alcohol and a 1:1 mixture of benzene-alcohol, is placed in an experimental Valley beater (Model 109C), about 3 liters of distilled water are added, and the wood is beaten for about 2 hours with a 2.5-kg. weight on the bedplate. The wood is soon hydrated and the suspension of the partly beaten wood becomes so thick that it stops moving in the beater. The mixture is diluted again with water and the beating continued with a 4.5-kg. weight on the bedplate. When the consistency again becomes too thick, more water is added to allow free movement of the pulp. After about another 4 hours the weight on the bedplate is increased to 6.5 kg. and the beating is continued for 8 to 10 hours. After this time, the wood is so finely distributed that it can no longer be felt between the fingers. The suspension is then centrifuged for 5 minutes at 3500 r.p.m., the supernatant solution is passed through a supercentrifuge at 20,000 r.p.m., and finally passed through a Schleicher and Schüll filter no. 588, giving a slightly bluish solution similar to a very dilute milk. It contains about 0.8 to 1 gram wood substance per liter.

On concentration of the solution under reduced pressure at a temperature not above 40°C. (water bath temperature), it becomes slightly viscous, and the wood begins to separate as a slimy voluminous precipitate. During the concentration, drops of the concentrated solution spatter into the upper part and the neck of the distilling flask where they evaporate to dryness and form a transparent film which is insoluble in water. When the flask is dried the film peels off. Because of the colloidal dispersion of some iron from the beater, the film and the precipitated

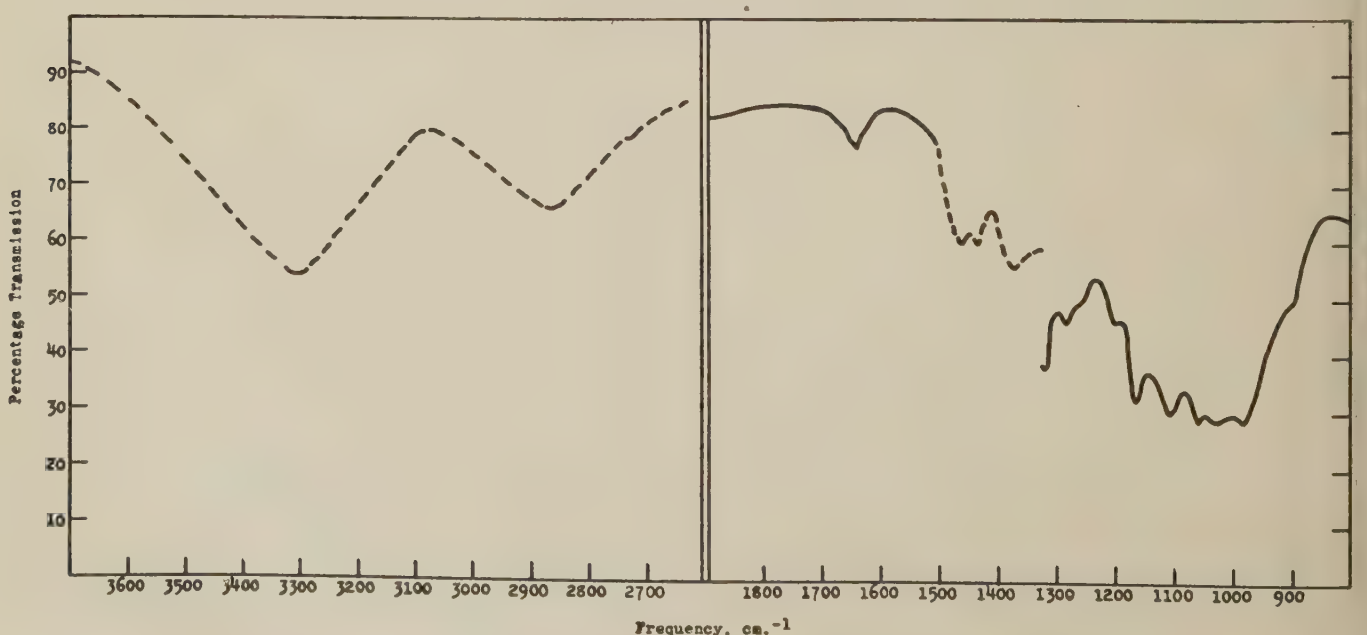

Fig. 5. Infrared spectrum of powdered cellulose (filter paper) in Nujol and perfluorokerosene

wood are light brown in color. The film is treated with a 1 to 2% solution of acid potassium oxalate for several hours, washed thoroughly with distilled water, and dehydrated with absolute alcohol, giving an almost colorless transparent film. This film is used for the determination of the infrared absorption spectrum.

ISOLATION OF THE WOOD FROM THE COLLOIDAL SOLUTION

The precipitate that separates during the concentration of the colloidal solution is either centrifuged, the supernatant solution poured off, and the precipitate taken up in methanol, or the mixture is further concentrated, methanol is added, and the residual water is distilled off *in vacuo* as an azeotropic mixture with the alcohol. The wood is then suspended in absolute methyl alcohol, filtered into a Soxhlet extraction thimble, and extracted successively with absolute alcohol, dioxane, ether, benzene, and low-boiling petroleum ether, with calcium oxide being added to the alcohol and barium oxide to the dioxane to assure complete dehydration. On careful drying of the wood in the paper cup in a vacuum desiccator over sulphuric acid, the colloidal wood is obtained as a light cream-colored, highly electrostatic powder of the same chemical composition as the original pre-extracted wood. It has a methoxyl content of 5.3%, a lignin content of 27.5%, and the latter, a methoxyl content of 14.3%.

DISSOLUTION OF THE COLLOIDAL WOOD IN SCHWEIZER REAGENT

In order to render the highly hydrated wood more readily soluble in Schweizer reagent, the centrifuged wood (containing about 3 grams of desiccator-dry material) is suspended in 50 ml. concentrated ammonium hydroxide, stirred a few minutes, and centrifuged. The light brown color of the supernatant solution indicates that some of the wood has been dissolved. The solution is concentrated *in vacuo*, whereby a part (A) of the dissolved material separates because of the removal of the ammonia; another part (B) is precipitated upon acidification with dilute acid. The regenerated wood, A and B (the yield and lignin content of which are now in process of determination), has a methoxyl content of 9.0%, indicating that this material has been enriched in lignin content. The centrifuged ammonium hydroxide-treated wood is then shaken with about 80 ml. cuprammonium hydroxide solution (containing 16 grams copper and 197 grams ammonia per liter), giving a gray-blue solution of the wood. This is centrifuged at 3500 r.p.m. for 10 minutes, causing the separation of only a minute precipitate. The wood can be recovered as a flocculent material from the solution by dropping it into dilute hydrochloric acid with stirring. The regenerated wood is centrifuged, washed well with distilled water, and then dehydrated as described before, giving a cream-colored powder. It has a methoxyl content of 5.98% and a lignin content of 35.8% indicating that some carbohydrate material has been degraded to water-soluble products. This is further shown by the fact that the wood regenerated from the same solution, after it had been kept for several weeks, had a methoxyl content of 6.2% and a lignin content of 39.2%. A reinvestigation of this phenomenon is under way. The solution can also be spun into threads which, however, are very brittle, as would be expected from the low viscosity of the solution. A film was prepared by pouring the solution on a glass plate, floating on mercury, and either exposing it to hydrogen chloride vapors or allowing the solution to dry in the open air and then treating it with dilute acid. The film also is very brittle. On extraction of the regenerated wood with 95% ethanol or with dioxane, no lignin is dissolved.

METHYLATION OF COLLOIDAL WOOD WITH DIAZOMETHANE

Into a suspension of about 5 grams (on the desiccator-dry basis) of moist collodial wood in which the water is chiefly replaced by dioxane, diazomethane (prepared from 41 grams nitrosomethylurea) is introduced, causing a lively evolution of nitrogen. After the material has stood overnight, a sample is isolated in the usual way and analyzed. It contains 49.7% carbon, 6.44% hydrogen, and 11.3% methoxyl [all on the ash-free (1.9%) basis]. The remainder of the wood is remethylated twice more causing an increase in the methoxyl content to 16.7%. In spite of the fact that this may not be the final value that can be reached with diazomethane, about half the wood is isolated and extracted with alcohol and dioxane. No lignin material can be detected in the extracts. The diazomethane-methylated product has a lignin content of 25.6%.

METHYLATION OF DIAZOMETHANE-PREMETHYLATED HOMOGENIZED SPRUCEWOOD WITH DIMETHYL SULPHATE AND SODIUM HYDROXIDE

The alcohol and dioxane-extracted premethylated wood is suspended in about 40 ml. water and methylated with 25 ml. dimethyl sulphate and 30 ml. 40% sodium hydroxide at 25°C., added over a period of 4 hours. The mixture is stirred another 5 hours, dialyzed overnight toward running distilled water, concentrated under reduced pressure, and methylated as before. After three such methylations the mixture is dialyzed and electrodialyzed, the water is removed by co-distillation with alcohol, and the methylated wood is extracted in a Soxhlet apparatus with ethanol and dixoane. It is then extracted with resorcinol dimethyl ether on a water bath. The solution is centrifuged and the clear and colorless solution is concentrated *in vacuo*. When the solution is dropped into anhydrous ether a white flocculent precipitate separates; this is washed with ether and petroleum ether and dried giving a white powder with a methoxyl content of 38.7%. The material, insoluble in resorcinol dimethyl ether, is isolated in the usual way and has a methoxyl content of 29.3%. No lignin determination has yet been made on these materials. Further methylation experiments, in addition to acetylation and sulphonation experiments, are in progress. The results of these will be the subject of a later publication.

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Studies on Modified Cellulose

II. The Hot Alkali Stability and Acid Hydrolytic Resistance of Modified Cellulose

ALEXANDER MELLER

Extensive oxidation of cotton cellulose by periodic acid resulted in oxycelluloses of increased moisture regain capacity. The increase in moisture regain resulting from oxidation of cotton cellulose with an acid solution of potassium dichromate was less pronounced and seemed to be complicated by superimposing effects. Reoxidation of dialdehyde oxycelluloses by chlorous acid had only a comparatively small effect on moisture regain. Chlorous acid oxidation of dichromate oxycelluloses decreased the moisture adsorption significantly, suggesting that uronic acid carboxyls present in oxycelluloses may either possess a lower "affinity" for water or that they may be involved in the formation of cross bonds and contribute to a lower accessibility to water vapor. The moisture regain capacity of hydrocelluloses prepared by means of hot acid solutions showed a decreased moisture regain power. Hydrocelluloses prepared by cold acid solution showed a slightly greater moisture adsorption. The moisture adsorbing capacity of gluconic acid oxycelluloses was only slightly greater than that of the parent hydrocelluloses. On converting oxycelluloses containing uronic acid carboxyls into calcium salts the moisture regain capacity increased considerably. A close relationship appears to exist between moisture regain capacity and acid hydrolytic resistance of modified celluloses. A similar close relationship was found between carbonyl group content of oxycelluloses and their hot alkali stability. While acid hydrolytic resistance of modified celluloses is overwhelmingly influenced by physical structural characteristics, their hot alkali stability is predominantly affected by chemical constitution. The increased moisture regain capacity of oxycelluloses in which the carboxyl groups have been converted to calcium salts indicates that in drying of such oxycelluloses the extent of cross-bond formation (involving probably secondary valence type of bonds) is reduced.

In a recent paper (*1*), on the effect of chemical modification of cellulose fibers on their hot alkali stability, it was suggested that oxidizing and hydrolyzing solutions may bring about some changes in their physical fine structure and that these changes may as well influence their hot alkali stability. In particular, the rate at which modified celluloses are fragmented and dissolved by alkali solutions can be expected to be significantly influenced by their accessibility to aqueous solutions. The accessibility, in turn, depends to a large extent on physical structural factors. The supermolecular structural factors seem to govern (1) the rate of fragmentation of cellulose fibers by acid solution (*2–6*) and hence determine their acid hydrolytic resistance, and (2) their moisture adsorbing power (*7, 8*). Both the rate of acid hydrolysis and the moisture adsorbing capacity of cellulose fibers have been applied to interpret the distribution of supermolecular structural building units, generally referred to as amorphous and crystalline regions.

The underlying idea of the method of interpreting the results of moisture regain measurements of cellulosic fibers in terms of distribution of easily and difficultly accessible fractions present is that the greater the easily accessible fraction in a cellulose sample the higher is its moisture regain capacity upon drying.

The influence of chemical modification of cellulose fibers on their moisture regain capacity has received very little attention. One of the main difficulties in establishing correlations between adsorbing capacity and chemical modification of cellulose is associated with the fact that most chemical modifications brought about by aqueous reagents may simultaneously change the physical fine structure of the fibers. Thus the measured moisture regain may be the result of a superposition of chemical and physical structural effects and the separation of the two factors is rather difficult. While a small change in the chemical constitution of cellulose fibers may not alter appreciably their moisture adsorbing power (*9*), extensive oxidation (*10*) or certain types of oxidation (*11*) may significantly influence this property. In connection with the latter statement reference should be made to the observation that periodate oxidation resulting in an increased moisture adsorbing power was accompanied by extensive changes in the physical structure of cotton cellulose as evidenced by the relevant x-ray diffraction photographs.

The present investigation was concerned with establishing the effect of physical, structural, and chemical constitutional changes of cellulose fibers brought about by (1) hydrolyzing and oxidizing agents and (2) calcium

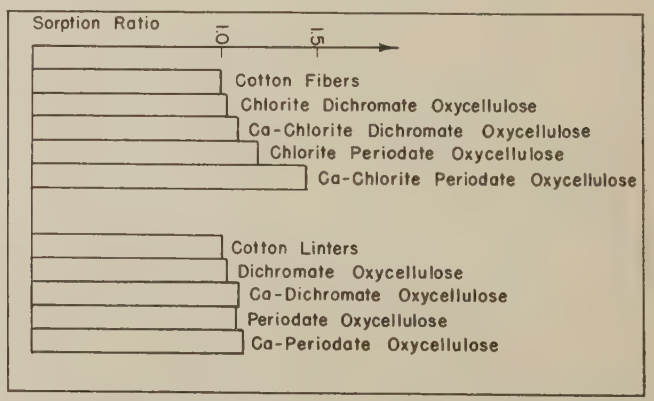

Fig. 1. Relationship between moisture regain and type of oxidation of cotton cellulose and the effect of calcium acetate treatment on moisture regain

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Table I. Conditions Applied in Preparing Modified Cotton Celluloses

	Temp., °C.	*Liquor to fiber ratio*	*Strength of solution*	*pH of solution*	*Period of treatment, hr.*
Cotton fibers					
Periodate oxycellulose IV	21	40:1	0.5 *N* HIO_4	4.6	140
Chlorite (5) periodate oxycellulose IV	25	30:1	0.4 *M* $HClO_2$	2.5	5
Dichromate oxycellulose III	21	30:1	0.1 *N* $K_2Cr_2O_7$	(0.2 *N* H_2SO_4)	162
Chlorite (5) dichromate oxycellulose III	25	30:1	0.4 *M* $HClO_2$	2.5	5
Hydrocellulose IV	75	30:1	1 *N* H_2SO_4	.....	4
Gluconic acid oxycellulose IV	25	30:1	0.4 *M* $HClO_2$	2.5	5
Hydrocellulose V	20	30:1	8 *N* H_2SO_4	.....	6
Gluconic acid oxycellulose V	25	30:1	0.4 *M* $HClO_2$	2.5	5
Cotton linters IPC					
Periodate oxycellulose IPC	22.8	40:1	0.5 *N* HIO_4	4.6	283
Chlorite periodate oxycellulose IPC	25	30:1	0.4 *M* $HClO_2$	2.5	5
Dichromate oxycellulose IPC	22.8	40:1	0.1 *N* $K_2Cr_2O_7$	(0.2 *N* H_2SO_4)	285
Chlorite dichromate oxycellulose IPC	25	30:1	0.4 *M* $HClO_2$	2.5	5
Hydrocellulose IPC (W)	75	30:1	1 *N* H_2SO_4	...	4.5
Gluconic acid oxycellulose IPC (W)	25	30:1	0.4 *M* $HClO_2$	2.5	5
Hydrocellulose IPC (S)	75	30:1	2.5 *N* H_2SO_4	...	4.5
Gluconic acid oxycellulose IPC (S)	25	30:1	0.4 *M* $HClO_2$	2.5	5

salt formation of the acid type of oxycelluloses on hot alkali stability and acid hydrolytic resistance.

The methods used for preparing the modified celluloses were described in a previous paper (*1*). Some further samples have been prepared and employed in the present investigation and they are described in Table I. It should be noted that the sample designated as dichromate oxycellulose IPC was treated with *N*/2 oxalic acid solution in order to decrease its chromium content. All the modified celluloses derived from cotton fibers were dried and stored at 70°F. and 65% R. H., while those prepared from cotton linters were dried and stored at 73°F. and 50% R. H.

The conversion of carboxyl groups of the acid type of oxycelluloses to the calcium salts was performed by applying a 1% calcium acetate solution at room temperature for 5 hours at a fiber to liquor ratio of 1:30. The excess calcium acetate was then washed out by distilled water and the preparations were dried at 70°F. (65% R. H.) and 73°F. (50% R. H.), respectively. The treatment with calcium acetate solution was applied to both wet and dried dichromate oxycellulose samples.

The moisture regain capacity was determined by drying a sample of 1 to 2 grams at 105°C. for 5 hours, and subsequent cooling in a desiccator, followed by exposure to an atmosphere of 65% R. H. at 70°F., or 50% R. H. at 73°F. until a constant weight was reached. The moisture regain capacity of the cotton fibers and cotton linters samples used for making the modified celluloses was determined simultaneously. By taking these values as unity, the relative moisture adsorption capacity of the modified celluloses was calculated. These values are recorded in Table II, as "Sorption Ratio."

The "hot alkali stability" was determined by heating a 0.75-gram sample under reflux at 100°C. with 150 ml. of 0.25 *N* sodium hydroxide solution for 2.5 hours and subsequent filtering, washing, drying, and weighing the insoluble residue.

The "acid hydrolytic resistance" was estimated by heating a 1.0-gram sample under reflux at 100°C. with 150 ml. of 8% hydrochloric acid solution for 2.5 hours and proceeding as described above.

The carbonyl group content was estimated by the hydroxylamine method, as described in a previous paper (*1*)

The results are listed in Table II and illustrated diagrammatically by the graphs and histograms.

DISCUSSION

Extensive oxidation of cotton cellulose by periodic acid resulted in oxycelluloses of increased moisture regain power when compared with the parent fibers. This result is in agreement with that obtained by Davidson (*11*). However, as mentioned in the introduction, periodic acid brings about chemical constitutional change (formation of dialdehyde oxycellulose) as well as physical structural change in cellulose. Both probably would contribute to its moisture adsorbing capacity. In addition drying of the modified celluloses may alter the physical fine structure of the preparations, as evidenced by the results discussed below. The increase in moisture regain resulting from oxidation of cotton cellulose fibers with an acid solution of potassium dichromate was less pronounced and

Table IIA. Sorption Ratio, Acid Hydrolytic Resistance, Carbonyl Content, and Hot Alkali Stability of Modified Cotton Celluloses Derived from Cotton Fibers

Cellulose sample	*Sorption ratio*	*Acid hydrolytic resistance*	*Apparent carbonyl content*[a]	*Hot alkali stability*
Cotton fibers	1.0	5.3	0.72	2.2
Periodate oxycellulose IV	1.141	25.8	15.40	45.5
Blank	1.037	...	...	...
Dichromate oxycellulose III	1.067	8.5	3.17	40.1
Blank	1.031	...	...	...
Chlorite (5) periodate oxycellulose IV	1.162	29.3	1.75	18.9
Chlorite (5) dichromate oxycellulose III	1.020	7.5	1.41	22.5
Hydrocellulose IV	0.954	4.7	0.71	17.8
Oxycellulose IV gluconic acid	0.963	5.5	0.66	7.08
Hydrocellulose V	1.005	6.5	0.65	9.5
Gluconic acid oxycellulose V	0.980	6.5	0.63	3.5
Mercerized cotton	1.573	11.1	0.65	0.6

[a] Moles per gram × 10^4

Table IIB. Sorption Ratio, Acid Hydrolytic Resistance, and Hot Alkali Stability of Modified Cotton Celluloses Derived from Cotton Linters

Cellulose sample	*Sorption ratio*	*Acid hydrolytic resistance*	*Hot alkali stability*
Cotton linters IPC	1	8.0	2.4
Dichromate oxycellulose IPC	1.028	9.5	43.7
Blank	1.070	...	...
Chlorite dichromate oxycellulose IPC	0.912	8.3	25.0
Ca-dichromate oxycellulose IPC	1.094	11.3	...
Periodate oxycellulose IPC	1.084	24.0	43.7
Chlorite periodate oxycellulose IPC	1.064	23.3	15.2
Ca-periodate oxycellulose IPC	1.119	24.1	...
Ca-chlorite periodate oxycellulose IPC	1.324	26.9	...
Hydrocellulose W	0.952	6.2	18.4
Gluconic acid oxycellulose W	0.982	6.4	12.8
Hydrocellulose S	0.848	5.7	31.7
Gluconic acid oxycellulose S	0.873	5.8	18.0
Ca-hydrocellulose S	0.865	6.0	...
Ca-gluconic acid oxycellulose S	0.882	6.0	...

is possibly complicated by superimposing effects. On treating the cotton samples with acid solutions without an oxidant ("blank" samples) the moisture regain capacity increased, which is presumably due to swelling of the fibers by the cold dilute acid solutions. The chromium retained by the fibers and present in the dichromate oxycelluloses may have also influenced the moisture adsorption.

Reoxidation of dialdehyde oxycelluloses by chlorous acid had only a comparatively small effect on moisture regain power. Chlorous acid oxidation of dichromate oxycelluloses significantly decreased the moisture adsorption. This finding would suggest that either uronic acid carboxyl groups possess a lower "affinity" for water than primary hydroxyl groups or that the uronic acid carboxyl groups are involved in the formation of cross bonds. The formation of cross bonds either of primary or of secondary valence character (hydrogen bonds) would contribute to a decreased surface for moisture adsorption.

The moisture regain capacity of hydrocelluloses prepared by means of hot acid solutions showed a lower moisture regain power than the parent cotton celluloses, which finding is in agreement with the results of other investigators (*7*, *8*). Hydrocelluloses prepared by cold acid solution showed a slightly greater moisture adsorption. This observation would be in harmony with the view that dilute cold acid solutions may increase the surface of the fibers by swelling and hence their adsorption capacity. On the other hand, hot acids would cause crystallization and may result in a decrease of the areas accessible for water vapor.

The moisture adsorption of gluconic acid oxycelluloses was only slightly greater than that of the parent hydrocelluloses.

It appears that uronic acid carboxyl groups present in dichromate oxycellulose in the free form contribute to a lower moisture regain, because by converting them to calcium salts the moisture regain capacity increased considerably. This suggests that the tendency for cross bond formation occurring when the oxycelluloses are dried, is reduced when the hydrogen in carboxyl groups is replaced by a cation. It is also possible that the affinity of the free carboxyl group toward water is smaller than that of the carboxylate ion. Evidence in support of the probability of the formation of secondary valence type of cross bonds involving free carboxylic groups and occurring during drying was found in the results with dichromate and chlorite dichromate oxycelluloses. The moisture regain capacity of the calcium acetate treated oxycelluloses derived from air-dried samples was lower than that prepared from wet (undried) samples, as shown by the histograms in Fig. 2.

A close relationship appears to exist between moisture regain capacity and acid hydrolytic resistance, as illustrated by the graph in Fig. 3. This would suggest that, within limits, both are governed by essentially the same structural characteristics of the fibers. The relationship, however, is not linear indicating that other factors as well play some role. In particular, with the periodate oxycelluloses, beside the change in physical fine structure, the stability of the chain molecules may also significantly change due to the opening of the anhydroglucose rings.

The hot alkali stability seems to be little influenced by supermolecular structural effects or it may be overwhelmingly affected by chemical constitutional factors. The relationship between apparent carbonyl group content of the oxycelluloses and their hot alkali stability is very close and is similar to that between

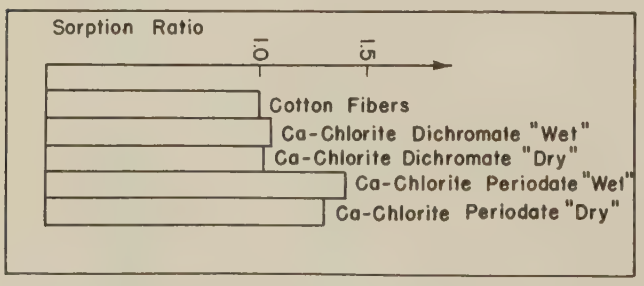

Fig. 2. The effect of drying oxycelluloses and subsequent calcium acetate treatment on moisture regain

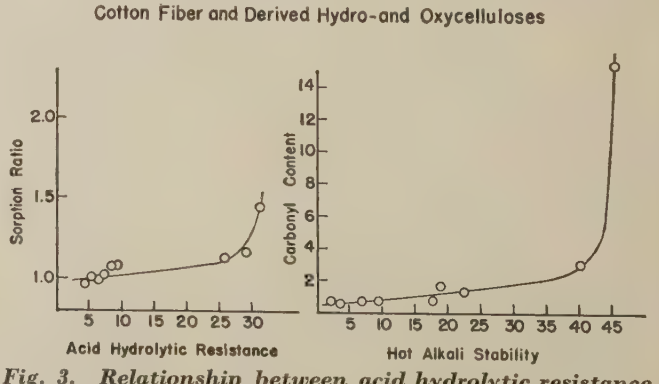

Fig. 3. Relationship between acid hydrolytic resistance and moisture regain and between hot alkali solubility and carbonyl group content of modified cellulose

moisture regain and acid hydrolytic resistance. Since the periodate oxycelluloses represent both chemically and physically modified celluloses the effect of the chemical modification on hot alkali stability may be superimposed by that of the physical structural change. However, when the chemical change is comparatively small, such as with hydrocellulose and gluconic acid oxycellulose, the overwhelming influence of physical structural factors on moisture regain and acid hydrolytic resistance is evident. Contrarily when the physical structural change is comparatively small, such as with dichromate and chlorite dichromate oxycelluloses, the effect of chemical constitutional factors, in particular carbonyl groups, on hot alkali stability seems to be decisive. Finally, it appears that the influence of uronic acid carboxyl group of oxycelluloses on moisture regain and acid hydrolytic resistance is, at least, partially due to a "secondary" effect brought about in dewatering such oxycelluloses.

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Thermal Decomposition of Chlorine Dioxide

RICHARD W. BROWN

Chlorine dioxide is a desirable bleaching agent for paper pulp because it oxidizes the coloring agents to colorless materials with almost no degradation of the cellulose. A product is obtained combining the strength properties of an unbleached pulp with a high degree of whiteness. The commercial use of chlorine dioxide has been limited mainly by its high cost but presumably also by a lack of knowledge of its general chemistry. The purpose of this study was to investigate the thermal decomposition of chlorine dioxide in both gas and solution phases and to determine the rate of the reaction between chlorine and chlorine dioxide. In the gas phase, chlorine dioxide undergoes thermal decomposition into chlorine and oxygen but, in aqueous solution, it undergoes catalytic hydrolysis into chloric and hydrochloric acids. If no catalyst is present the solutions are quite stable, even at 96.5°C. A catalyst apparently is produced by overheating an impure grade of potassium chlorate when preparing chlorine dioxide by the reaction of chlorate and oxalic acid. Even catalyzed solutions become stable after about 16 hours at 96.5°C. (about 40% hydrolyzed). Stability is produced by the build-up in hydrogen ion and chloride ion concentration. Attempts to identify the catalyst have been unsuccessful, although chlorine monoxide at a critical concentration does cause appreciable hydrolysis. The reaction between chlorine and chlorine dioxide does not follow a simple mechanism, although a second order reaction fits the data to a first approximation. Curves showing the rate of the reaction at different temperatures and molar ratios of reactants are given. Assuming that the reaction is second order, temperature coefficients were calculated and the energy of activation found to be 21,000 cal. per mole.

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The reaction between chlorine and chlorine dioxide does not follow a simple mechanism, although a second-order reaction fits the data to a first approximation. Curves showing the rate of the reaction at different temperatures and molar ratios of reactants are given. Assuming that the reaction is second order, temperature coefficients were calculated and the energy of activation found to be 21,000 cal. per mole.

Chlorine dioxide is an unstable compound which may decompose with explosive violence into chlorine and oxygen if present in a gas phase in a sufficiently high concentration. Bray (*1*) studied the thermal decomposition of aqueous chlorine dioxide solutions and found that at 0°C. decomposition took the form of hydrolysis [reaction (1)] but at higher temperatures

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Table I. Course of the Thermal Decomposition of Chlorine Dioxide at 96.5°C.

Gas phase volume, cc.	75	<1
Aqueous phase volume, cc.	25	75
Initial ClO_2 present, g.	0.0743	0.0612
Final ClO_2 present, g.	0.0012	0.0587
Oxygen produced, g.	0.0273	0
ClO_2 decomposed to Cl_2 and O_2, %	78	0
ClO_2 hydrolyzed to $HClO_3$ + HCl, %	....	4.1

actual decomposition into chlorine and oxygen occurred [reaction (2)]. He could not determine whether reaction (2) was a gas or solution-phase reaction but presumed it was both.

$$6ClO_2 + 3H_2O \rightarrow 5HClO_3 + HCl \quad (1)$$

$$ClO_2 \rightarrow {}^1/_2Cl_2 + O_2 \quad (2)$$

Two series of experiments have been performed which prove that reaction (2) occurs only when a gas phase is present. In the absence of a gas phase, chlorine dioxide in aqueous solution is either almost completely stable or hydrolyzes comparatively slowly. In the first series of experiments, sealed glass tubes which were about one quarter filled with chlorine dioxide solution were placed in a water bath at 96.5°C. for periods of about 12 hours. In the second series, the sample tubes were completely filled with solution except for a gas space of less than 1 cc. At the end of the reaction period, the tubes were cooled and the contents analyzed for chlorine, oxygen, chlorine dioxide, chloride ion, and chlorate ion. A comparison of the results of two typical experiments is given in Table I.

The results presented in Table I indicate that, when there is an appreciable gas phase, most of the chlorine dioxide present decomposes to chlorine and oxygen. The remaining chlorine dioxide which was consumed probably reacted with the chlorine produced.

In the absence of any appreciable gas phase, chlorine dioxide hydrolyzes slowly according to reaction (1). The theoretical ratio of chlorate ion to chloride ion according to reaction (1) is 5 to 1. In 48 experiments with samples of chlorine dioxide in an aqueous phase, an average value of 4.2 to 1 was obtained and no measurable chlorine or oxygen was formed. The fact that the ratio is less than 5 to 1 can be attributed to side reactions such as the reaction of chlorine and chlorine dioxide and the hydrolysis of chlorine [reactions (3) and (4)].

$$ClO_2 + {}^1/_2Cl_2 + H_2O \rightarrow HClO_3 + HCl \quad (3)$$

$$3Cl_2 + 3H_2O \rightarrow HClO_3 + 5HCl \quad (4)$$

HYDROLYSIS OF AQUEOUS CHLORINE DIOXIDE SOLUTIONS

Studies have been made on the rate of hydrolysis in the dark of a number of chlorine dioxide stock solutions at 96.5°C. The chlorine dioxide was generated from potassium chlorate and oxalic acid (*2*) in the absence of light and was stored at 0 to 10°C. in the dark. It was found that some of the solutions were almost completely stable, whereas others hydrolyzed appreciably. The data for solutions 6, 7, 4, and 10 are presented graphically in Fig. 1, in which the percentage chlorine dioxide hydrolyzed is plotted against the time. Inspection of Fig. 1 shows a pronounced difference in behavior between solutions 6 and 7 and 4 and 10. Solutions 9 and 12 gave rate-of-hydrolysis curves similar to 6 and 7 but solutions 8 and 11 were similar to 4 and 10. Two types of chlorine dioxide stock solutions can thus be distinguished: (1) those which are virtually stable at 96.5°C. and (2) those which hydrolyze relatively rapidly at 96.5°C. and finally reach a stable condition after about 16 hours, when they are about 40% hydrolyzed.

The differences in hydrolytic activity of the two types of stock solutions have been traced to the actual preparation of the chlorine dioxide. All solutions were prepared from reagent grade oxalic acid and distilled water, but in some cases a technical grade and in others a reagent grade of potassium chlorate was used. The temperature of preparation also varied somewhat. Variations in procedure and the qualitative hydrolytic activity of the solutions are shown in Table II.

It appears that the hydrolysis is catalyzed by some substance which is produced from an impurity in the technical grade potassium chlorate. This substance apparently was not found to the necessary extent in solution 4, during the preparation of which the temperature was kept below 65°C.

The difference in catalytic activity in the various stock solutions makes it impossible to calculate reaction rate constants which would be applicable to more than one stock solution. However, the rate of hydrolysis can be compared with the rate of thermal decomposition in the gas phase. From Table I it is seen that the chlorine dioxide in the gas phase is almost completely decomposed after 10 hours. In the aqueous phase, however, even the most reactive solutions reached a state of equilibrium after about 16 hours, when about 40% of the chlorine dioxide had decomposed. This difference in reaction rate further emphasizes the difference between the gas- and the solution-phase reaction.

The stable condition which is attained by stock solutions which are hydrolytically active might indicate a reversible chemical reaction. It has been shown (*1*) that reaction (5) will proceed with solutions approximately one molar in hydrochloric and chloric acids.

$$HClO_3 + HCl \rightarrow ClO_2 + {}^1/_2Cl_2 + H_2O \quad (5)$$

The concentrations of these acids in the present studies were between 10^{-2} and 10^{-3} molar. A series of experiments was performed to determine whether such dilute solutions would produce chlorine dioxide. The solutions used were approximately 2×10^{-2} molar in hydrogen ion, 4×10^{-3} molar in chloride ion, and 1.6×10^{-2} molar in chlorate ion. Even after 22 hours at 96.5°C., no detectable chlorine dioxide was formed. This, together with the fact that no chlorine was found on analysis at the end of the hydrolysis experiments,

Table II. Hydrolytic Activity of Chlorine Dioxide Solutions

Solution	*Grade of potassium chlorate*	*Temp. of preparation, °C.*	*Activity of solution*
4	Technical	60–65	Stable
6	Technical	60–70[a]	Hydrolyzed
7	Technical	60–70[a]	Hydrolyzed
8	Reagent	60–70	Stable
9	Technical	68–72	Hydrolyzed
10	Reagent	60–69	Stable
11	Reagent	70–72	Stable
12	Technical	68–72	Hydrolyzed

[a] Initial temperature about 75°C.

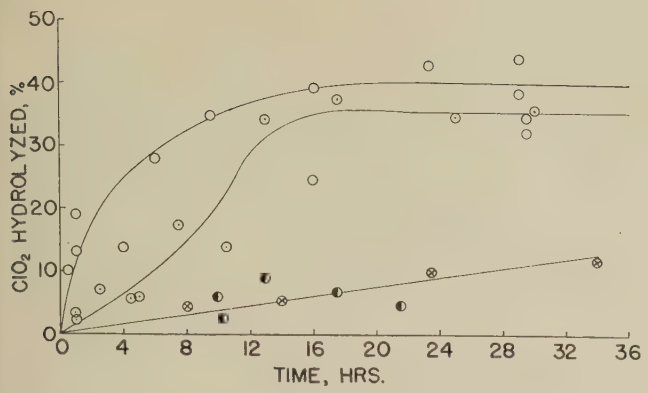

Fig. 1. Comparison of the rate of hydrolysis of chlorine dioxide solutions

○ Solution 6 ⊗ Solution 10
⊙ Solution 7 ◐ Solution 4

indicates that reaction (5) does not proceed under the conditions used in this work.

It is indicated that the buildup of hydrogen and chloride ions stabilizes the solutions. This has been demonstrated by adding different amounts of the three ions produced during hydrolysis to samples of hydrolytically active chlorine dioxide solutions. The solutions were allowed to react at 96.5°C. for 20 to 26 hours, which was sufficiently long to insure that the solutions had become stable. The results of these experiments are summarized in Table III.

Detailed analysis of the data in Table III shows that the combination of the chloride ion and hydrogen ion almost completely prevents the hydrolysis of a solution which is normally active. Chloride ion by itself is quite effective when present in sufficient concentration. Chlorate ion, on the other hand, seems to favor hydrolysis and partially counteracts the effects of the other ions when present with them.

CATALYSTS FOR CHLORINE DIOXIDE HYDROLYSIS

It has been proposed that some material is produced during the generation of chlorine dioxide which catalyzes hydrolysis when aqueous solutions are allowed to react at 96.5°C. A series of experiments was performed to determine the nature of this catalyst. A number of different substances were added to solution 8, which was normally stable, and the degree of hydrolysis was determined after various intervals at 96.5°C. The reasons for choosing the various catalytic agents may be mentioned briefly. Tap water was used to

Table III. Effect of Cl^-, ClO_3^-, and H^+ on ClO_2 Hydrolysis

Solution	*Initial ClO_2, (mole/l.) × 10^3*	*Initial ClO_2 decomposed, %*	*Cl^- added, (mole/l.) × 10^3*	*ClO_3^- added, (mole/l.) × 10^3*	*H^+ added, (mole/l.) × 10^3*
9	13.73	44.8	0	0	0
9	11.92	29.1	0.88	0	4.84
9	7.81	29.7	0	2.31	3.17
9	12.86	28.3	1.00	3.97	5.45
9	11.98	6.9	1.99	7.95	13.42
9	12.71	10.5	4.24	15.90	23.32
12	11.69	48.2	0	0	0
12	11.47	27.0	0	0	12.73
12	11.07	19.2	2.10	0	0
12	10.12	4.5	1.76	0	11.30
12	11.62	42.1	0	7.28	11.30
12	7.82	36.9	0.87	3.46	5.55
12	12.68	26.6	1.01	4.24	6.80
12	10.48	14.3	1.76	7.06	11.30
7	15.15	37.4	0	0	0
7	4.47	6.3	2.52	9.97	12.92

Table IV. Catalytic Effect of Various Agents on Chlorine Dioxide Hydrolysis at 96.5°C.

Agent added	*Concn. of agent, (mole/l.) × 10^3*	*Time, hr.*	*Initial ClO_2 with agent*	*Hydrolyzed, % without agent*
NaCl	4.63	17	11.4	7.3
HCl	9.44	20 1/2	6.5	7.6
$KClO_3$	7.48	17	9.6	7.3
$HClO_4$	13.32	5	4.0	2.7
$HClO_4$	13.32	21 1/2	17.2	7.8
Cl_2O	0.20	24	24.0	7.9
CO_2-saturated water in tube	...	13 1/2	7.4	6.3
10 cc. tap water	...	5	2.5	2.7
Initial pH adjusted to 5.0	...	5	4.1	2.7
H_2O_2	5.45	5	23.0	2.7
H_2O_2	7.92	22 1/2	24.5	7.9
H_2O_2	0.43	5 1/4	3.4	2.8
H_2O_2	0.44	22 1/2	7.1	7.9

determine the effect of impurities in the distilled water. Hydrogen peroxide was used as an example of peroxy compounds which might be present. Carbon dioxide is one of the products of the generation of chlorine dioxide, and chlorine monoxide or perchloric acid might also be formed during the preparation. As mentioned before, chlorate apparently counteracts the effects of chloride and hydrogen ions on hydrolysis. Bray (*2*) has claimed that chloride ion catalyzed hydrolysis. The results given in the previous section show

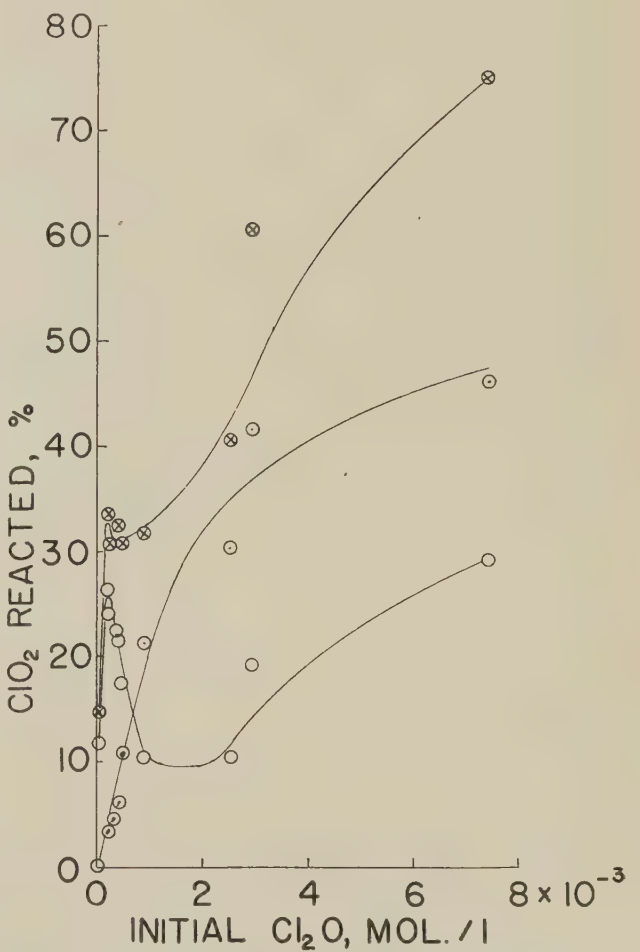

Fig. 2. Catalytic effect of chlorine monoxide on the hydrolysis of chlorine dioxide

○ ClO_2 hydrolyzed
⊙ ClO_2 reacted with Cl_2O
⊗ Total ClO_2 consumed

that the effect was just the reverse but it was necessary to confirm this with further experiments. The results are summarized in Table IV.

Chlorine monoxide catalyzed the reaction. The results with the other substances were in general negative. Chloride ion did not have a catalytic effect thus confirming the previous work and contradicting Bray's results. Perhaps perchlorate ion catalyzed the reaction but insufficient data are available to reach a conclusion. Hydrogen peroxide caused considerable hydrolysis; the effect seems to depend on concentration, indicating a possible stoichiometric rather than a catalytic reaction. In all cases, the degree of hydrolysis is considerably less than that for active solutions (such as 6 or 7) after a comparable period, indicating probably that the actual catalyst has not been found or that the proper conditions were not used.

The catalytic activity is independent of the vessel surface. Six different reaction vessels have been used; there was no relation between a particular vessel and the degree of hydrolysis. Active solutions hydrolyzed equally and stable solutions were equally inactive in any vessel.

In analyzing the experimental data obtained when chlorine monoxide was added to chlorine dioxide, it was necessary to assume that several reactions occurred. Chlorine monoxide hydrolyzes in water to give hypochlorous acid. The hypochlorous acid reacts with any hydrochloric acid present to give chlorine which, in turn, reacts with the chlorine dioxide. Reaction (6) represents the over-all process. It was assumed that

$$4ClO_2 + Cl_2O + H_2O \rightarrow 2HCl + 4HClO_3 \qquad (6)$$

reaction (6) accounted for all the chlorine monoxide consumed. In order to account for the observed deviation of the chlorate:chloride ratio from the theoretical value of 2 to 1, it was also necessary to assume that reactions (1), (2), and (4) took place to some extent.

In the first experiments various amounts of chlorine monoxide solution, prepared by the method of Secoy and Cady (*3*), were added to chlorine dioxide samples and allowed to react at 96.5°C. for 18 to 22 hours, which was long enough for virtually complete reaction. The percentage of the initial chlorine dioxide hydrolyzed and that which reacted with the chlorine monoxide were determined by finding what combination of the

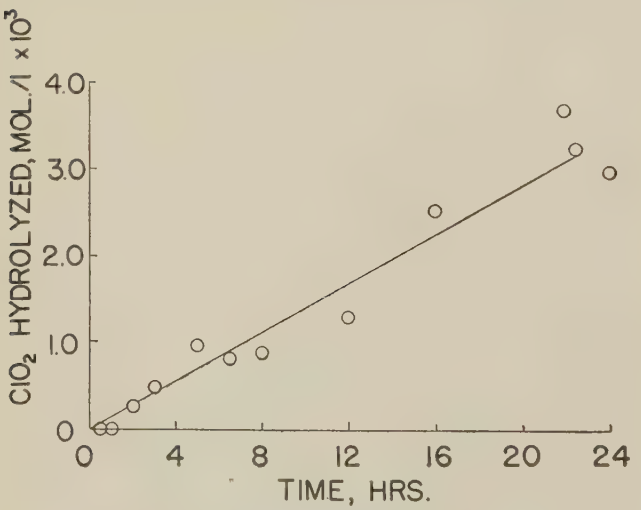

Fig. 3. Rate of hydrolysis of chlorine dioxide catalyzed by chlorine monoxide

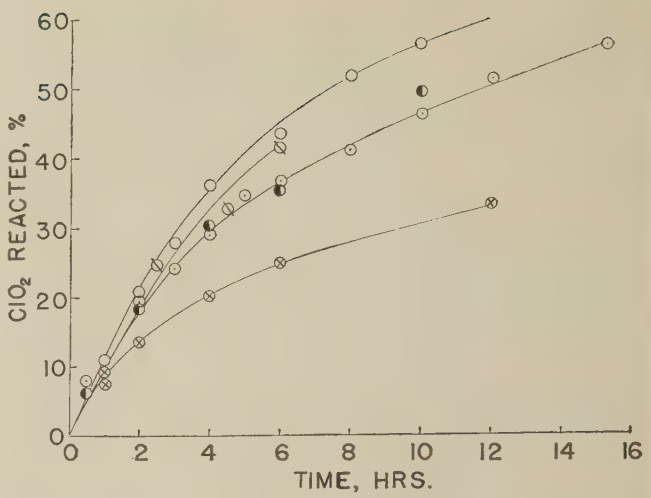

Fig. 4. The rate of the reaction of chlorine with chlorine dioxide at 96.5° C.

○ Series A ⊗ Series C
⊙ Series B ø Series E
Series F

different reactions would account for the experimental data obtained. The results are shown in Fig. 2, in which the total percentage of chlorine dioxide consumed, the percentage hydrolyzed, and the percentage which reacted with chlorine monoxide are plotted against the initial molar chlorine monoxide concentration. The initial chlorine dioxide concentration in the series varied from 8.2 to 14.3 $\times 10^{-3}$ mole per liter.

Figure 2 reveals the significant fact that chlorine monoxide catalyzes the hydrolysis of chlorine dioxide solutions and possesses a sharp maximum in catalytic activity at a concentration of about 0.2 $\times 10^{-3}$ mole per liter. At this point, hydrolysis accounts for about 75% of the chlorine dioxide which disappeared. This means, actually, that about 24% of the initial chlorine dioxide is hydrolyzed.

The rate of hydrolysis of chlorine dioxide catalyzed by chlorine monoxide was determined with samples containing 0.2 to 0.3 $\times 10^{-3}$ mole of chlorine monoxide per liter and an average initial chlorine dioxide concentration of 12.9 $\times 10^{-3}$ mole per liter. The samples were analyzed after various time intervals at 96.5°C., and the amount of chlorine dioxide hydrolyzed was calculated and plotted against time in Fig. 3. The points fall fairly well along a straight line, which is an indication that the reaction is zero order with respect to chlorine dioxide. Catalytic reactions are often zero-order reactions, because the rate depends on the catalyst rather than on the concentration of the reactant. Thus, the kinetic data confirm the hypothesis that chlorine monoxide catalyzes the hydrolysis. The zero-order reaction rate constant, as taken from the slope of the curve, is 0.14 $\times 10^{-3}$ mole per liter per hour.

Although chlorine monoxide catalyzes the hydrolysis, it is probably not the catalyst present in the stock solutions which hydrolyze spontaneously. The rate of the chlorine monoxide-catalyzed hydrolysis was considerably slower than the rate of hydrolysis of the active solutions. After 24 hours, the chlorine monoxide-catalyzed solutions were only about 24% hydrolyzed and showed no sign of becoming stable, whereas the other solutions were about 40% hydrolyzed after this

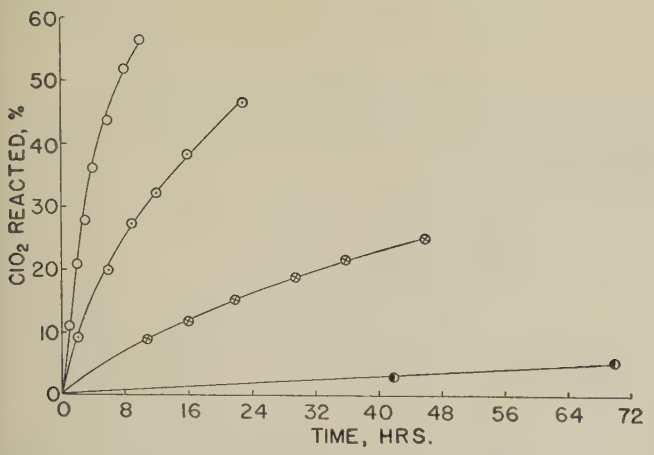

Fig. 5. The effect of temperature on the rate of reaction of chlorine with chlorine dioxide

○ Series A ⊗ Series H
⊙ Series G ◐ Series I

time and had become stable. It seems likely that this difference in behavior is due to differences in catalytic agents rather than to differences in reaction conditions.

RATE OF REACTION BETWEEN CHLORINE AND CHLORINE DIOXIDE

Experiments on the rate of reaction between chlorine and chlorine dioxide were carried out at 38, 60, 80, and 96.5°C., although most of the work was done at 96.5°C. Several series of experiments were run at 96.5°C. with different initial concentrations of reactants. The average concentrations for the various series are summarized in Table V.

The experiments were carried out by adding the proper amounts of chlorine and chlorine dioxide to a sample tube and allowing the reaction to proceed at 96.5°C. After the proper time, the tube was cooled and the contents were analyzed. The experimental data are explained by assuming that reaction (3) is the predominant reaction and is accompanied by reaction (4). Since the chlorine dioxide solution did not hydrolyze appreciably, reaction (1) could be neglected.

The percentage of the initial chlorine dioxide which reacted with the chlorine was calculated and plotted against time. Figure 4 shows the rate at different molar ratios of chlorine dioxide to chlorine at 96.5°C. and Fig. 5 shows the effect of temperature at a constant molar ratio. Figure 4 indicates that the rate of reaction increases with the molar ratio and that solutions with the same molar ratio have the same rate of reaction, even though the actual initial concentrations vary widely.

The amount of chlorine hydrolyzed was small and, in most cases, accounted for less than 10% of the initial chlorine present. The effect of chlorine hydrolysis was neglected in considering the reaction kinetics. Some error is introduced by this but it is justified by the simplification which results when an attempt is made to calculate a reaction rate constant.

A number of attempts have been made to find a reaction rate equation which would fit the experimental data. A qualitative examination showed that the rate depended on both the chlorine and the chlorine dioxide concentration. The simplest general expression for this is:

$$dx/dt = k(a - x)^m(b - x/2)^n \qquad (7)$$

Table V. Initial Concentrations of Cl_2 and ClO_2 for Different Series

Series	Temp., °C.	Initial ClO_2, (mole/l.) × 10^3	Initial Cl_2, (mole/l.) × 10^3	Initial Cl_2/ initial ClO_2
A	96.5	8.17	8.07	0.98
B	96.5	8.24	4.73	0.57
C	96.5	9.29	2.45	0.26
E	96.5	11.65	6.05	0.52
F	96.5	15.61	8.16	0.52
G	80.0	8.89	8.06	0.91
H	60.0	9.43	8.46	0.90
I	38.0	8.38	7.83	0.95

In this equation x is the amount of chlorine dioxide reacted in time t, k is the reaction rate constant, a is the initial concentration of chlorine dioxide, b is the initial concentration of chlorine, and m and n are exponents (either fractional or integral).

Various values of m and n were tried on a trial-and-error basis. Examination of the previous results helped in deciding the values to use in the next trial. Finally a term $(x)^{-p}$, where p is a fractional exponent, was added because a qualitative analysis indicated that this might rationalize the data. The general expression is:

$$dx/dt = k(a - x)^m(b - x/2)^n(x)^{-p} \qquad (8)$$

The validity of an equation was tested by substituting the experimental data into its integrated form and calculating k. The constancy of k was observed and any trends were determined by plotting k against a, b, t, and x. Only the equations of the form of equation (7), with integral values of m and n, could be integrated directly into an equation from which k could be calculated. The remaining equations were integrated graphically using the mechanical integrator described by Van den Akker (*4*).

None of the reaction rate equations tested fits the data well. A typical example of the variation found in the value of k is furnished by considering the results obtained when the reaction is assumed to be second order and the second-order reaction rate constant (k_2) is calculated. The differential form of the equation

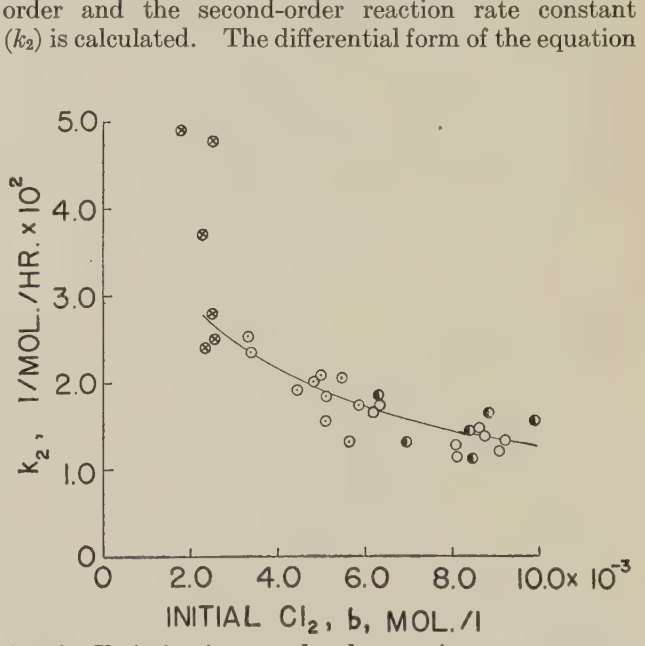

Fig. 6. Variation in second-order reaction-rate constant, k_2, with initial chlorine concentration, b, for the reaction of chlorine with chlorine dioxide

○ Series A ⊗ Series C
⊙ Series B ◐ Series F

Table VI. Temperature Coefficient of Chlorine-Chlorine Dioxide Reaction

Temp., °C.	*Average k_2, l./mole/hr.*	*Temp. coefficient*
38	0.98×10^{-4}	
		4.41
60	9.53×10^{-4}	
		2.56
80	4.88×10^{-3}	
		2.46
96.5	1.98×10^{-2}	

expressing the rate of a second-order reaction is equation (7) with both m and n equal to one. This can be integrated readily and k_2 determined by substituting the experimental data into the integrated expression.

The values of k_2 at 96.5°C. are constant to a first approximation but show definite trends when plotted against b (Fig. 6) or against t (Fig. 7). No significant trend is obtained if the results are plotted against a. The trend when k_2 is plotted against x is similar to that shown with t.

Some of the equations of the form of equation (8) give slightly more constant values of k than the second-order rate equation. The best results are obtained with the equation in which $m = 1$, $n = 0.5$, and $p = 0.2$. However, a relationship still exists between k and t or x even in this case, and the values of k vary over a two to one range. Sufficient trials were carried out to show that no equation of the form of either (7) or (8) will give values of k which show no trend with t or x. This indicates that a very complicated reaction rate equation must be found if the data are to fit. It does seem probable, however, that the chlorine dioxide concentration will enter to the first power and the chlorine concentration to some power less than one, perhaps one half.

The temperature coefficients of the reaction can be calculated if it is assumed as a first approximation that the values of k_2 represent the true reaction rate. By taking the average of the calculated values of k_2 at each temperature, results are obtained which may have the correct value relative to each other, although the absolute values may not represent the reaction rate closely. The average values of k_2, together with the temperature coefficient representing the change in reaction rate for a 10° rise in temperature in the indicated temperature range, are given in Table VI.

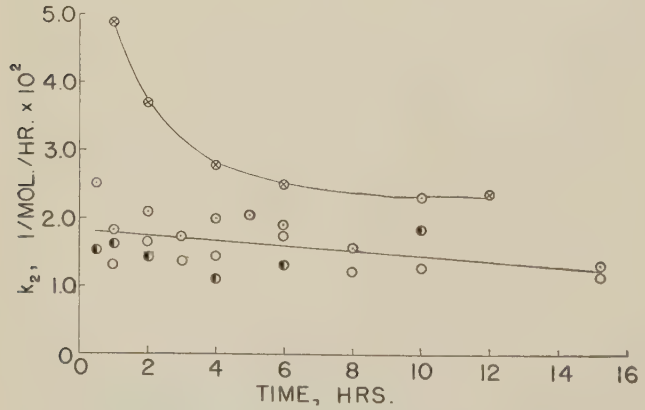

Fig. 7. Variation in second-order reaction-rate constant, k_2, with time for the reaction of chlorine with chlorine dioxide

○ Series A ⊗ Series C
⊙ Series B ◐ Series F

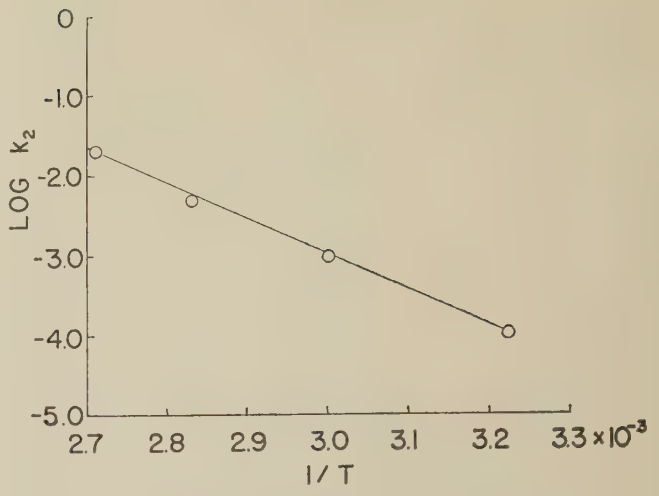

Fig. 8. The application of the Arrhenius equation to the reaction of chlorine with chlorine dioxide

Log second-order reaction-rate constant vs. reciprocal temperature

The energy of activation of the reaction can be calculated from the average values of k_2 in Table VI, using the Arrhenius equation $\ln k_2 = C - E/RT$, where E is the energy of activation, R is the gas constant, T is the absolute temperature, and C is the constant for a particular reaction. The value of E may be determined from the slope of the straight line obtained by plotting $\ln k_2$ against $1/T$. The experimental data fit a straight line very well, as is seen from Fig. 8. The energy of activation as determined from the slope of the line in Fig. 8 is 21,000 cal. per mole.

APPLICATION OF RESULTS

The experimental results discussed have certain direct practical applications to problems in the use of chlorine dioxide for pulp bleaching. It may be concluded that aqueous chlorine dioxide solutions can be stored for relatively long periods at ordinary temperatures with very little loss of oxidizing power because of hydrolysis. In the gas phase, however, there is considerably more chance of decomposition. Precautions should especially be taken to avoid exposure of chlorine dioxide in the gas phase to excessive heat. Even if the gas phase is so dilute that there is no explosive hazard, there is considerable chance of losing an appreciable amount of oxidizing power through decomposition.

The reaction between chlorine and chlorine dioxide is sufficiently slow so that no significant loss in oxidizing power would be expected during several days' storage of solutions of the two gases at moderate temperatures. Actual bleaching may, of course, be carried out at higher temperatures but, since the time is relatively short, there should be no appreciable loss, provided that the chlorine-chlorine dioxide reaction is not accelerated under bleaching conditions.

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ASSOCIATION NEWS AND EVENTS

Third Coating Conference

The Third Coating Conference of the Technical Association of the Pulp and Paper Industry will be held at the Sherman Hotel, Chicago, Ill., on May 5–8, 1952. John H. Heuer of the Great Northern Paper Co., Millinocket, Me., is Chairman of the TAPPI Coating Committee. Fred E. Culp of the Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis., is Program Chairman. Associated with him is Norman Kennedy, Corn Industries Research Foundation, New York, N. Y.; J. G. Bullard, Corn Products Sales Co., New York, N. Y.; F. D. Long, Container Corp. of America, Chicago, Ill.; and V. V. Vallandigham of Kelco Co., Chicago, are in charge of local arrangements.

A planning meeting was held in Chicago on January 4 and was attended by Fred Culp, J. G. Bullard, F. D. Long, V. V. Vallandigham, Norman Kennedy, Corn Industries Research Foundation, New York, N. Y., and C. C. Kesler, Penick & Ford, Cedar Rapids, Iowa.

The program starting Monday, March 5, will be devoted to papers on starch. The program has been completed and will discuss subjects. J. G. Bullard is in charge of this part of the program.

1. What will be the future requirements of starch for paper coating work (from the viewpoint of the paper coater) and what is fundamental research doing to meet these requirements (from the viewpoint of a starch research chemist), by F. H. Frost, S. D. Warren Co., Cumberland Mills, Me., and Dr. Thomas Schock of the Corn Products Refining Co., Argo, Ill.
2. Flow properties of starch coatings by Mr. Gallagher, A. E. Staley Co., Decatur, Ill. (This paper will outline some of the work done using the Hercules viscosimeter and will cover the following subjects: Modification of flow properties of starch-sized coatings by changing type of starch used; Use of modifiers such as soap liquefiers; Use of rheological data to study the nature and design of modifications.
3. Water-resistant starch coatings by Mr. Black of Penick & Ford Ltd., Inc., Cedar Rapids, Iowa.
4. The use of chlorinated starch for paper coating by Dr. Newton, Clinton Foods, Inc., Clinton, Iowa.
5. Dextrines for paper coating by T. A. White, National Starch Products, Inc., New York, N. Y.
6. The fundamentals of adhesion by Dr. Klein, National Bureau of Standards, Washington, D. C.
7. Use of enzymes in the preparation of starches as adhesives for starch coatings, Dr. Mason, Anheuser Busch, Inc. This paper is intended to cover the preparation of enzymes, their application, and the various factors of control in their use. It is also expected to cover the various measurements employed both in the control of the enzymes modification as well as the control necessary for the preparation and production of high solids coating colors.
8. Panel Discussion on the use of starch in paper coating. (Panel members to be appointed.)

The following papers will be presented in the general sessions. Fred E. Culp will have charge of this part of the program.

1. "Hot Resin Coated Papers as Barrier Materials," by L. F. Swec and L. M. Burgess, H. P. Smith Paper Co., Chicago, Ill.
2. "A Rheological System for Analyzing the Flow Properties of Pseudoplastic Materials," by R. N. Thompson, Calgon, Inc., Pittsburgh, Pa.
3. "The Toughest Job in the World" (Evaluation of coated printing papers) by R. C. Hydell, Mead Corp., Chillicothe, Ohio.
4. "Evaluating Coating Surfaces for Lithography," by O. H. Somers, Western Printing and Lithographing Co., Racine, Wis.
5. "Pick Testing," by R. F. Reed and Gordon Wheeler, Lithographic Technical Foundation, Chicago, Ill.
6. "Large Scale Preparation of Clay Slips," by H. M. Hughson, Provincial Paper Ltd., Thorold, Ont.
7. "Enzyme Treatment of Starch-Clay Mixtures," by J. E. Wilber, St. Regis Paper Co., Deferiet, N. Y.
8. "Use of Starch in the Manufacture of Coating Raw Stock," by N. M. Frisch, Stein, Hall & Co., New York, N. Y.

On Thursday morning, May 8, there will be two organized plant visits. One will be to the Corn Products Refining Co. plant at Argo, Ill., and the other to the American Maize Products Co. plant near Chicago. It is possible that visits to R. F. Donnelly, Cuneo Press, W. F. Hall, or other large printing plants may be arranged.

The speaker at the Coating Conference Luncheon will be Peter J. Massey of Chicago.

Reservations for rooms at the Hotel Sherman, Randolph and Clark Streets, Chicago, Ill., should be made direct with John Vidovic, Director of Sales.

TAPPI Secretary Honored

On Jan. 27, 1952, R. G. Macdonald, Secretary-Treasurer of the Technical Association of the Pulp and Paper Industry was the commencement speaker at the graduation exercises of Western Michigan College in Kalamazoo, Mich. The topic of his address was "Values." On this occasion he was also conferred the honorary degree of Doctor of Science by the College.

Fundamental Research Committee

The Fundamental Research Committee is being reorganized. The present committee was established in 1932 and has made many contributions toward the advancement of the industry. These have included a large number of papers read at Association meetings, several symposia, and two major monographs. Harry F. Lewis of The Institute of Paper Chemistry has been the Chairman of the Committee. To him and his associates, especially W. Boyd Campbell of the Pulp and Paper Research Institute of Canada, much credit is due.

In the reorganized committee which will have the same name the personnel will consist only of individuals who are active in the research programs of the industry. This will serve as a planning group and working subcommittees will be organized as needed. One of these will be a Subcommittee on Wood Chemistry. Dr. Lewis will be Chairman of the new Fundamental Research Committee.

Changes in Annual Meeting Program

The program of the TAPPI Annual Meeting published in the January issue of *Tappi* is still substantially correct.

The following papers have been added:

"Stress-Strain Behavior of Wet Strength Paper," by T. S. Morse, R. T. Mashburn, and W. H. Markwood, Jr., Hercules Powder Co., Wilmington, Del.

"An Investigation of the Air Drying of Paper," by James J. Higgins, Ohio Boxboard Co., Rittman, Ohio.

"Polyester Resins, Laminating and Molding Compounds," by M. H. Bigelow, Plaskon Division, Libbey-Owens-Ford Glass Co., Toledo, Ohio.

A paper scheduled for the Plastics Session has been transferred to the Wet Strength Session: "New Methods of Adding Neoprene Latex to Pulp," by R. N. Walsh, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. A paper to be given by H. G. Bimmerman was listed in the Plastics Session program. The listing was in error and the only paper on neoprene will be given by Mr. Walsh.

Container Testing Committee

The Container Testing Committee was reorganized in February, 1951. It was planned, in many respects, to be different than any container testing committee that has operated in the past.

The Committee was formed around a solid core of advisers that were especially selected because they were themselves technically inclined in one or more phases of the container business, and they were chosen to represent a definite phase of the container business such as set-up boxes; folding cartons; protective reinforcements such as twine, steelstrap, and tape; paper tubes; cannisters and barrels; paper shipping sacks, bags, and multiwall bags; adhesives, laminates, and thin applications; corrugated and solid fiber shipping containers; and by no means the least, the representation of a strong purchasing agents association to maintain at all times the consumer viewpoint.

The Committee is now so organized that it can deal with problems of coordination in packaging, one of the serious difficulties that has always had a bearing on package testing. For instance, the purpose of using a container of any kind or a multiplicity of containers is to get merchandise from the end of the production line that produced that merchandise to the customer in exactly the same condition that it was in when it left the end of the production line as a finished product. In any ordinary merchandise, protection is achieved by a multiplicity of packaging materials cooperating with each other to make the finished shipping package. Testing that is done on any one component of the finished package can now have in its test procedure, expert opinion on the relationship of forces caused by the other component parts.

During the past year the advisory board of the Committee held two meetings, the first on April 17 at Atlantic City and the second, on October 3 at Cleveland, Ohio.

In the program planned for the February meeting at New York the following agenda has been prepared:

1. Select a Chairman for 1952, 1953.
2. Appoint a Committee Secretary for 1953.
3. Make any changes in appointments to the Advisory Board that seem necessary.
4. Give consideration to an enlarged scope for the Advisory Board with additional members.
5. A discussion of continuing projects of the Committee in the order as listed in the *TAPPI Year Book*.
6. A report by H. T. Scordas on a test method for manufacturers' joints with discussion by the Committee.
7. A report by F. A. Wilcox on definitions with open discussion by the Committee and a survey of the Committee for the addition of words peculiar to their particular segment of the industry.
8. Charles Zusi will report on a questionnaire prepared for circulation to determine methods of measurement for containers of all sizes and descriptions.
9. Ed Dahill will report on suggested methods for testing fiberboard in categories over 250 pounds.
10. Charles Zusi will report on a series of movies for the standardization of test methods already accepted.
11. A discussion of the revision of test T 403 m-47 as recommended by the Pulp and Paper Research Institute of Canada.
12. Complete discussion of the possibility of adopting the following American Society for Testing Materials tentative standards in TAPPI: ASTM D 996–50, Terms Relating to Shipping Containers; ASTM D 782–47, Revolving Hexagonal Drum Test; ASTM D 880–50, Incline Impact Test; ASTM 775–47, Drop Test for Shipping Containers; ASTM D 997–50, Drop Test for Cylindrical Shipping Containers; ASTM D 959–50, Drop Test for Bags; ASTM D 642–47, Compression Test; ASTM D 951–47 T Water Resistance of Containers by Spray Method; ASTM D 895–47 T Water Permeability of Packages; ASTM D 1008–48 T Penetration of Liquids into Submerged Containers;
13. A committee will be assigned to rewrite those standards accepted.
14. New business and place of future meetings.

College Alumni Luncheons

The following college alumni luncheons and dinners have been scheduled to be held during the TAPPI Annual Meeting:

Institute of Paper Chemistry: Hotel Lexington, Monday, February 18, at 6:30 p.m.

Massachusetts Institute of Technology: Engineers Club, 32 West 40th Street, Wednesday, February 20, at 12:00 m. Prof. Warren K. Lewis of M.I.T. will be the speaker.

University of Maine: Bowman Room, Hotel Biltmore, Wednesday, February 20, at 12:30 p.m.

College of Forestry, State University of New York: Hendrik Hudson Room, Roosevelt Hotel, Wednesday, February 20, at 12:30 p.m.

The TAPPI Fibrary

Efforts to organize a collection of pulp fibers authentic as to species and process were begun in October, 1949, when a form questionnaire was sent to each member of TAPPI requesting a list of pulp fibers which he had available for such a collection. It was pointed out that each company need submit only one list. The responses indicated a lively interest in this type of reference file. At this point The Institute of Paper Chemistry accepted the responsibility of acting as the custodian of the proposed fiber collection.

During the succeeding year the custodian checked the offers for duplication, contacted potential donors, and cataloged samples which were submitted. An attempt was made to obtain extensive coverage of species and also, when feasible, to include as many donors as possible. The end of November, 1950, was set as the deadline for samples to be included in the first catalog.

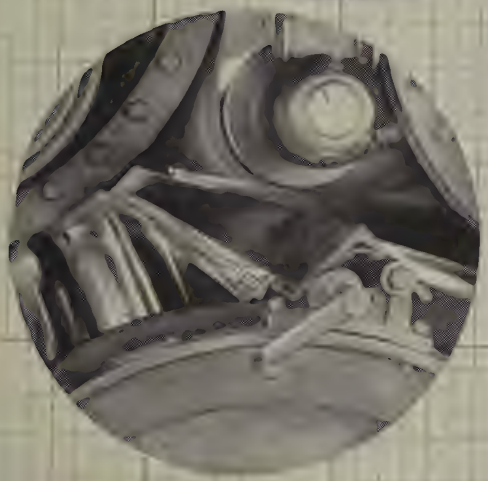
The first catalog of the TAPPI Fibrary was published in the February, 1951, issue of *Tappi* (34, No. 2: 26A, 28A, 30A, 32A). A limited supply of reprints is available. A total of 194 samples were listed with coverage of approximately 80 species of wood, bast, seed-hair, leaf, and monocotyledonous stem fibers. An introduction preceding the listing of samples explained how they might be obtained by writing the Fibrary, The Institute of Paper Chemistry, Appleton, Wis. It was requested that the nominal service charge of 25 cents ($0.25) per sample be sent when ordering the samples. Unfortunately, lack of time prevented the custodian from checking the authenticity of the samples listed in the catalog before it was published but this was done as items were sent out in response to orders. It is the intent to verify the samples as to species and process before addenda are published.

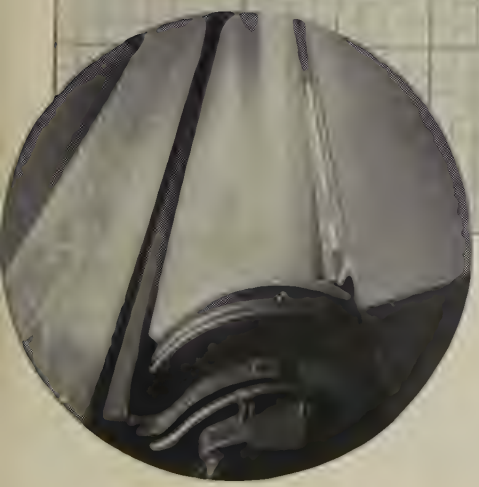
In 1951 requests for fibers were received from approximately twenty organizations and totaled 567 individual items. These requests ran the gamut from one sample to the entire list in the case of two who wished to begin their own collection.

A considerable number of new fibers are on hand at present and as soon as their authenticity has been verified the first addendum to the catalog will be published. It is our hope that this new listing will appear in an early issue of *Tappi*.

The custodian is grateful to all donors and to all members of TAPPI who have assisted in this undertaking. It is essential that additional species be submitted by those who have them in order that this collection of fibers may be enlarged and increase in value to our industry.

IRVING H. ISENBERG, *Fibrarian*





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PERSONAL MENTION

Items About New and Old Tappimen

New TAPPI Members

William Acton, Consulting Engineer, Pulp and Paper Research Co. Ltd., London, E.C. 4, England, a graduate of Manchester College of Technology.

Karl J. Adamik, Professor of Paper Technology, Technical University, Graz, Austria, a graduate of the Technical University, Graz.

Jack J. Arnold, President, Paper Corp. of America, New York, N. Y.

Joe B. Aust, Abrasive Testing Engineer, The Carborundum Co., Niagara Falls, N. Y., a 1923 graduate of Mississippi State College.

Frances L. Beckwith, Librarian, Forest Products Laboratory, Madison, Wis.

Robert E. Betts, Engineering Librarian, Texas Engineers Library, College Station, Texas, a 1931 graduate of the University of North Carolina.

William H. Bolger, Manager of Laboratories, Robert W. Hunt Co., Chicago, Ill., a 1923 graduate of the University of Illinois.

Edward L. Borg, Group Leader, Naugatuck Chemical Div., U. S. Rubber Co., Naugatuck, Conn., a 1937 graduate of Rensselaer Polytechnic Institute.

Lars Bovin, Chief Engineer, Westerviks Papperbruks AB, Vastervik, Sweden, a graduate of Örebro Technical College.

Joseph Cutro, Sales Engineer, The Black-Clawson Co., Hamilton, Ohio, a 1947 graduate of Purdue University.

Gerrit De Gelleke, Project Engineer, Cameron Machine Co., Brooklyn, N. Y., a 1933 graduate of Stevens Institute of Technology.

Clarence R. Eckert, Director of Research, The Ruberoid Co., South Bound Brook, N. J., a 1909 graduate of the University of Cincinnati.

Cleveland M. Fair, Assistant to Owner, W. W. Henderson & Sons, Pensacola, Fla.

William W. Fitzhugh, Jr., Executive Vice-President, William W. Fitzhugh, Inc., New York, N. Y., a 1935 graduate of Dartmouth College.

Alexander D. Frascella, Chief Draftsman, Cameron Machine Co., Brooklyn, N. Y.

Charles A. Gallaer, Assistant Chief Engineer, Buell Engineering Co., Inc., New York, N. Y., a 1949 graduate of Cooper Union.

Kenneth M. Gaver, Research Associate, The Keever Starch Co., Columbus, Ohio, a 1945 graduate of Ohio State University.

Willard H. Gehrke, Supervisor, Process Engineering Converting Section, Marathon Corp., Menasha, Wis., a 1943 graduate of the University of Wisconsin.

Travis L. Gordy, Engineering Representative, Continental Oil Co., Ponca City, Okla., a 1946 graduate of the University of Oklahoma.

Yoshikazu Hachihama, Professor of Engineering, Osaka University, Osaka City, Japan, a 1925 graduate of Tohoku Imperial University.

Eiji Hayakawa, Technical Official, Ministry of Intertrade and Industry, Government Chemical Industrial Research Institute, Tokyo, Japan, a graduate of Kanazawa Technical College.

William H. Hipshire, Plant Engineer, Moraine Paper Co. Div., W. Carrollton, Ohio.

Richard C. Hoch, Chemist, Endura Mfg. Corp., Quakertown, Pa., a 1950 graduate of Lehigh University.

Robert M. Husband, Assistant Professor, Cellulose Industries, Dept. of Chemical Engineering, University of Toronto, Toronto, Ont., Canada, a 1944 graduate of the University of Saskatchewan, with a Ph.D. degree from McGill University in 1947.

Walter K-G. Kaemmerer, Director, Papierfabrik G.m.b.H. Vormals Brueder Kaemmerer, Osnabrueck, Germany, a graduate of the Technical University, Darmstadt.

Robert G. Kaiser, Sales Engineer, The Rotareaed Corp., Bronxville, N. Y., a 1945 graduate of Newark College of Engineering.

Harry C. Kerman, Vice-President and General Manager, Commercial Alcohols Ltd., Montreal, P. Q., Canada, a 1920 graduate of the University of Toronto.

Franklin F. Landis, Southeastern Representative, Bauer Bros. Co., Springfield, Ohio, a 1943 graduate of the University of Cincinnati.

Arthur E. Levensailor, Assistant Superintendent, Bureau of Tests, Great Northern Paper Co., Millinocket, Me., a 1948 graduate of the University of Maine.

Robert W. Long, Mill Manager, Container Corp. of America, Wabash, Ind., a 1937 graduate of the University of Toledo.

Warren W. Macklem, Sales Engineer, The Black-Clawson Co., Hamilton, Ohio, a 1940 graduate of Tri-State College.

Eugene F. McCarty, Technical Control Supervisor, Nekoosa-Edwards Paper Co., Port Edwards, Wis., a 1944 graduate of the University of Minnesota.

George S. McKnight, Jr., Coating Research Group Leader, Oxford Paper Co., Rumford, Me., a 1941 graduate of Dalhousie University.

Douglas H. McMurtire, Chemical Engineer, Brown Co., Berlin, N. H., a 1915 graduate of the Massachusetts Institute of Technology.

Edward W. Midlam, Director, Technical Service, Cit-Con Oil Corp., Lake Charles, La., a 1929 graduate of Lehigh University.

Glenn B. Neuman, Salesman, E. I. du Pont de Nemours & Co., Inc., Providence, R. I., a 1930 graduate of Ohio State College.

Edwin H. Olmstead, Vice-President, The Eaton-Dikeman Co., Mt. Holly Springs, Pa., a 1938 graduate of the Massachusetts Institute of Technology.

Kazuki Ono, Professor, Naniwa University, Osaka-Prefecture, Japan, a 1929 graduate of Kyusyu Imperial University with a Dr. of Agr. degree.

Alex C. Ormond, Chief Design Engineer, Mill Engineering Dept., Union Bag & Paper Corp., Savannah, Ga., a 1940 graduate of Georgia Institute of Technology.

Luis Cruz Palomers, Merchant, Tapachula, Chis., Mexico.

Michael Petrowski, Jr., Chemical Engineer, Carolina Paper Board Corp., Charlotte, N. C., a 1950 graduate of North Carolina State College.

Donald M. Platt, Project Engineer, Crown Zellerbach Corp., Camas, Wash., a 1951 graduate of Oregon State College.

Robert C. Polk, Technical Applications Engineer, Cameron Machine Co., Brooklyn, N. Y., a 1940 graduate of New York University.

William H. Roberson, Technical Service Engineer, Hercules Powder Co., Wilmington, Del., a 1948 graduate of the University of Tennessee.

Interesting Facts about Paper

The word "stationery" comes down from the Middle Ages when most people were unable to read and write. Monks set up *stations* in churchyards where they wrote and read for their parishioners. In time, paper and other things were sold. and when this became a trade its practitioners were known as "stationers." England's copyright office is still known as "Stationers Hall."

interesting facts about
QUINOZOL BLUE BP DUSTLESS

Quinozol Blue BP Dustless is a bright Acid Blue possessing excellent solubility, light fastness and level dyeing properties. It is the blue which is most extensively used in the production of blues and greens for bond and cover stock where a minimum of two-sidedness and good light fastness is desired.

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William F. E. Robinson, Chief Technician, William Howard & Son Ltd., Chartham Paper Mills, Chartham, Nr. Canterbury, Kent, England, a 1938 graduate of Poly Technical College.

Leonard Rockstrom, Vice-President in Charge of Engineering, Cameron Machine Co., Brooklyn, N. Y., a 1940 graduate of New York University.

Felix W. Saco, Project Engineer, Cameron Machine Co., Brooklyn, N. Y., a 1940 graduate of New York University.

Carl-Robert Sahlberg, Technical Manager, Backhammars Bruk AB, Bjorneborg, Sweden, a 1929 graduate of the Technical University, Stockholm.

Charles W. Schaar, Director of Research and Chemical Purchases, Cromwell Paper Co., Chicago, Ill., a 1940 graduate of Loyola University.

Robert A. Scheiderbauer, Research Manager, E. I. du Pont de Nemours & Co., Inc., a 1941 graduate of the University of Minnesota, with a Ph.D. degree.

Leonard B. Schlosser, Assistant to the President, Schlosser Paper Corp., New York, N. Y., a 1947 graduate of Williams College.

Morton A. Slavin, Assistant General Manager of Manufacture, Erving Paper Mills, Erving, Mass., a graduate of Oklahoma A. & M. College.

Samuel Sochrin, Purchasing Agent, Paper Corp. of America, New York, N. Y., a 1933 graduate of New York University.

Elmer D. Sutherland, Assistant Director, Quality Control, Personal Products Corp., Milltown, N. J., a 1939 graduate of Ripon College.

John H. Sutliff, Certified Pulp Tester, Slingerlands, N. Y.

Edward A. Taub, Vice-President, Gibraltar Corrugated Paper Co., Inc., North Bergen, N. J.

Walter D. Taulman, Owner, W. D. Taulman and Associates, Atlanta, Ga. Attended the University of Cincinnati.

Paul F. Thiele, Secretary-Treasurer and General Manager, Thiele Kaolin Co., Sandersville, Ga., a 1936 graduate of the University of Wisconsin.

Harald Thormahlen, Manager, Liebermann, Walechli & Co., New York, N. Y., a 1941 graduate of Matthiass Claudius College, Hamburg, Germany.

Austin H. Tifft, Assistant Group Leader, Pulping Research, Oxford Paper Co., Rumford, Me., a 1942 graduate of Yale University.

Antonio Tormo, Chemist, Fabrica de Papel Patuel S. A., Valencia, Spain.

Marshall R. Turner, Director, Escuela de Ingenieria Forestal, Merida, Venezuela.

L. J. van der Wolk, Librarian, Delft Technical University, Delft, Holland, a graduate of the University of Leyden with a Dr. of Chem. degree.

Raymond C. Wagner, Research Engineer, National Gypsum Co., Kalamazoo, Mich., a 1951 graduate of Western Michigan College.

Robert A. Webber, Assistant to Director of Research and Development, Brown Co., Berlin, N. H., a 1918 graduate of the University of Illinois.

Ross C. Wilcox, Assistant Manager, Chemical Div., Marathon Corp., Rothschild, Wis., a 1932 graduate of Tufts College.

Sein Win, Mechanical Engineer, Longview Fibre Co., Longview, Wash., a 1951 graduate of Oregon State College.

Leonard J. Wood, Jr., Supervisor, National Starch Products, Inc., New York, N. Y., a 1943 graduate of Abilene Christian College.

TAPPI Notes

E. V. Alderson, Sales Representative for Heppenstall Co., has moved his office from Boston to 734 Asylum Avenue, Hartford, Conn.

E. G. Bennett is now President and General Manager of the Escanaba Paper Co., Escanaba, Mich.

Carl J. Bergendahl, formerly of Pagel, Horton & Co., is now Managing Director of Hafrestroms A/B, Haverud, Sweden.

J. O. Boesinger, Pulp Mill Superintendent for the Mead Corp., has been transferred from Harriman, Tenn., to Nashville, Tenn.

Ralph M. Buechler, formerly of The Black-Clawson Co., is now sales engineer for the D. J. Murray Manufacturing Co., Wausau, Wis.

Abbott Byfield is now Manager of the New Product Development Division, Kimberly-Clark Corp., Neenah, Wis.

Harvey P. Cannon is convalescing at Knollin Farms, Sandy Creek, N. Y.

Ellsworth J. Cook, formerly of Steiner Sales Co., is now Technical Director for the Paper Corp. of America, Cheboygan, Mich.

Robert F. DeLong has transferred from Rothschild, Wis., to the Converted Products Research Department of the Marathon Corp., Menasha, Wis.

Foster P. Doane, Jr., formerly of the Sandy Hill Iron & Brass Works, is now Production Manager for the Bergstrom Paper Co., Neenah, Wis.

Carl Gustave Geiger, formerly of Amotfors Pulp & Paper Co., is now President of Fiskeby Fabriks A/B, Norrkoping, Sweden.

M. A. Hadi is now in charge of the control and research laboratories of Sirpur Paper Mills Ltd., Sirpur-Kaghaznagar, India.

Waldemar Jensen is now Professor of Chemistry and Chemical Technology of Forest Products at Abo Akademi, Abo, Finland.

Peter J. Jerardi, formerly Chief Engineer of The Black-Clawson Co., is now Assistant Works Manager of Baldwin-Lima-Hamilton Corp., Hamilton, Ohio.

Frederick C. Keeney, formerly student at The Institute of Paper Chemistry, is now Project Chemist for Weyerhaeuser Timber Co., Pulp Division, Everett, Wash.

W. Oliver Kincannon, Jr., formerly of W. C. Hamilton & Sons, is now Technical Sales Representative for the PMC Dept., Hercules Powder Co., Wilmington, Del.

Frantisek Kosmal, formerly President of the Czechoslovak Paper & Woodpulp Mills, is now with the Cellulose Research Institute, Bratislava, Czechoslovakia.

Pfc. Arthur H. Lambert, formerly Chemist for the Container Corp. of America, is now instructor in offset press operation at the Engineer School, Fort Belvoir, Va. He would like information on Army map stock (high wet strength) and other data on offset printing. He may be addressed at Hq. Co. 1st Sch. Bn., T.E.C.R., Fort Belvoir, Va.

Donald W. Libby, formerly of the Solvay Process Co., is now Research Associate and Project Leader at the College of Forestry, State University of New York, Syracuse, N. Y.

M. C. McDonald, formerly President of the Chesapeake Corp. of Virginia, is now President of the Great Northern Paper Co., Millinocket, Me.

Robert Magruder, formerly of the St. Regis Paper Co., is now Assistant to the Manager, Paper Corp. of America, Cheboygan, Mich.

Henry L. Mellen is now District Manager of the PMC Dept., Hercules Powder Co., Holyoke, Mass.

Edward H. Niederauer is now Vice-President of the Escanaba Paper Co., Escanaba, Mich.

William H. Owens, Chief Engineer of the Philip Carey Mfg. Co., has transferred from Lockland, Ohio, to Plymouth Meeting, Pa.

Samuel E. Raia is now Coordinating Inspector for the Champion Paper & Fibre Co., Pasadena, Tex.

R. W. Ramsdell, formerly of Penick & Ford Ltd., Inc., is now in the Technical Sales Dept. of Hercules Powder Co., Holyoke, Mass.

Robert D. Rusch, formerly of the International Paper Co., is now Paper Mill Superintendent for the Mosinee Paper Mills Co., Mosinee, Wis.

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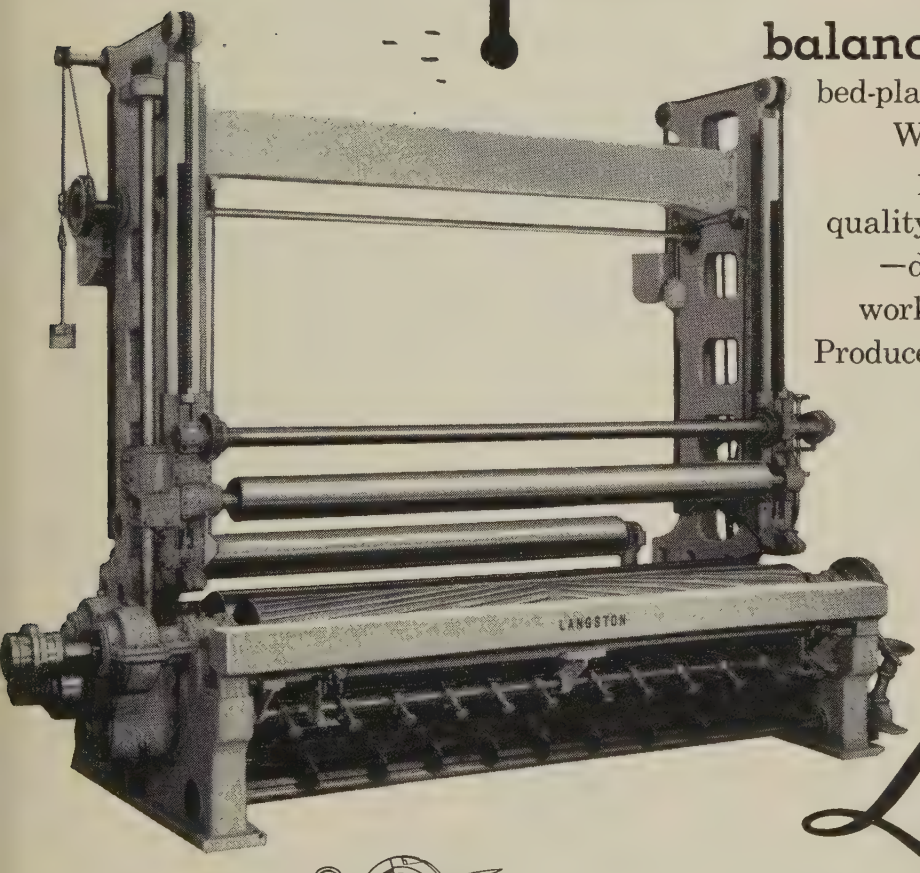

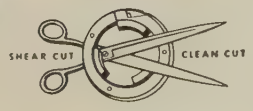

Langston

slitters and winders

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John K. Russell, formerly of Northeastern Paper Products Ltd., is now Assistant General Manager of Lignosol Chemicals Ltd., Quebec, P. Q.

Albert J. Smith, formerly of the Commonwealth Engineering Co., is now Sales Engineer for Midwest-Fulton Machine Co., Dayton, Ohio.

Edward J. Sullivan, formerly of the NPA, is now a member of the sales staff of George W. Millar & Co., Inc., New York, N. Y.

Richard T. Trelfa, formerly of the Hercules Powder Co., is how Technical Director of the Watervliet Paper Co., Watervliet, Mich.

Robert T. Van Derveer, formerly of Triangle Publications, Inc., is now Sales Engineer for S K F Industries, Inc., Philadelphia, Pa.

Victor Wirpas, formerly of the St. Regis Paper Co., is now Sales Representative for the Sutherland Paper Co., Kalamazoo, Mich.

R. M. Wright, formerly of Wright, Learmonth (Pty) Ltd., is now Managing Director of Papercraft (Pty) Ltd., Pretoria, South Africa.

* * *

E. E. Archibald, Jr., has succeeded Roland Wilber as the official corporate representative of Potlatch Forests, Inc., Livingston, Idaho, in TAPPI.

* * *

Warren S. Kumblad has succeeded *J. F. Butterworth* as the official representative of the Socony-Vacuum Oil Co., New York, N. Y., in TAPPI. Mr. Butterworth has been transferred to St. Louis, Mo.

William H. Monsson has succeeded *John S. Coey* as the official representative in TAPPI of the Hooker Electrochemical Co., Niagara Falls, N. Y.

Industry Notes

1951 was the biggest year in history for both dealers and consumers of wastepaper. Mill purchases during the year approximated 9 million tons, as against a previous high of 7,895,000 tons in 1950. Consumption approximated 8,750,000 tons, as against a previous high of 8,009,000 tons in 1947.

* * *

A new film "Trees to Paper" produced by the American Forest Products Industries, Inc., is now available for general distribution. This is a sound film, requiring about $12^1/_2$ minutes to show, and depicts the story of the manufacture of paper. Copies may be obtained on loan from the American Paper & Pulp Association or permanent copies may be obtained from the A.F.P.I., Inc., 1319 Eighteenth Street, N. W., Washington 6, D. C.

* * *

Because of a general shortage of raw materials for papermaking in India the Chief Controller of Exports has issued notice that the export of old hemp rope cuttings will not be allowed, effective immediately.

The current price of No. 1 old rope in the United States is now about $10.75 per 100 pounds.

* * *

The cost of producing a metric ton of pulp in Sweden today averages between 300 to 400 crowns including depreciation of equipment, but excluding the cost of pulpwood which averages 350 to 400 crowns (U. S. $1.00 = Sw. Kr. 5.18) delivered to the mill for the volume needed to make a ton of pulp. Since the export fees in the present fourth quarter range from 450 to 490 crowns per ton and the average export price averaged 1000 crowns above that amount, the net profit to the producer should be about 275 crowns (U. S. $52.25) per ton. As pulp and paper prices have apparently ceased to increase and the prices for both labor and pulpwood are rising sharply and the latter are expected to soar next year, a strong case is made by the producers that the profits of the industry in 1952 will not only be reasonable, but, "very small."

According to the daily press, the average price of all standing timber purchased (in various ways) this fall is about 70 crowns a cubic meter, which averages 60 to 70% higher than prices a year ago. In one year spruce pulpwood has risen from 46 to 62 crowns a cubic meter and fir, from 37 to 57 crowns.

* * *

Ceiling Price Regulation 107 spells out ceiling prices applicable to pulpwood produced in Minnesota, Wisconsin, and Michigan. This regulation governs the price of pulpwood consumed by about 55 wood pulp mills. Thirty-five mills in Wisconsin used about 60% of the pulpwood consumed in this area. Ten mills in Michigan used about 16%.

Consumption of pulpwood by these mills in 1951 was at the rate of 3 million cords annually. Several hundred thousand cords are imported annually from Canada and are not subject to ceilings when imported directly by the consumer. About 70% of the pulpwood is purchased with bark on. Thirty per cent, mostly poplar, is purchased peeled.

Pulpwood is normally cut in this area in 100-inch lengths and a cord is not less than 128 nor more than $133^1/_3$ cubic feet. For poplar, cut in special 55-inch lengths the cord is 147 cubic feet, and a higher ceiling is allowed because of the increased cost in cutting and because the shorter lengths may be piled more compactly.

Following are the ceilings, per cord, delivered by the seller at his expense, f.o.b. railroad cars or at landings on the Great Lakes or connecting waterways:

Species	*Rough*	*Peeled*
Spruce	$25.00	$30.00
Balsam fir	22.00	27.00
Jack pine	18.00	23.00
Hemlock	18.00	23.00
Tamarack	16.00	21.00
Poplar	14.00	19.00
Poplar (55-inch length)	16.80	21.80
White birch	15.00	20.00
Miscellaneous hardwoods	13.00	18.00

* * *

The Defense Production Administration's Industrial Facilities Expansion Summary issued at the end of the year showed that 3660 Certificates of Necessity have been issued for a proposed investment of $9,854,614,000, of which tax amortization of $6,445,114,000 is allowed.

Of this total the Paper and Allied Products Industries have been alloted 82 certificates, covering a proposed investment of $511,916,000, of which 52.6% or $269,488,000 has been allowed for accelerated tax amortization.

When and if this expansion materializes, increased annual production is expected as follows:

Wood pulp	2,561,000 tons
Paper	428,000 tons
Paperboard	1,483,000 tons

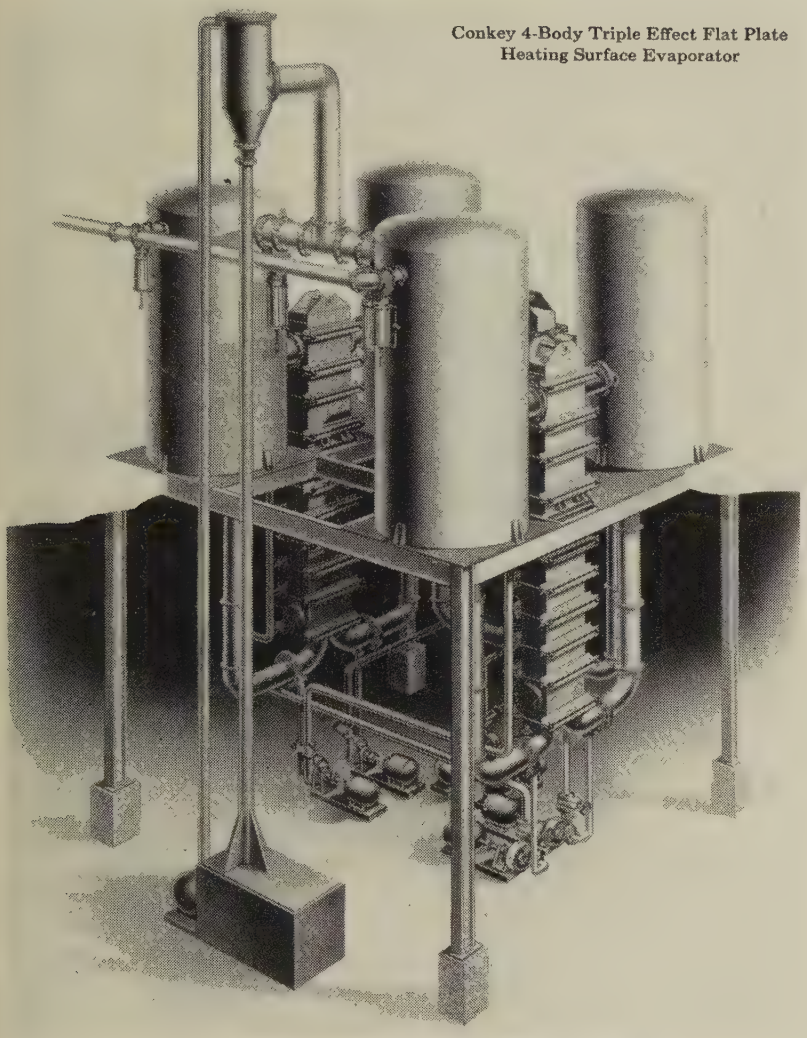
The estimated 1951 production of wood pulp is about 16,500,000 tons.

Production of both paper and paperboard will aggregate about 26,500,000 tons.

Pending applications for rapid tax amortization certificates involve an expenditure of another $500,000,000. These new proposed facilities would raise annual output still further as follows:

Wood pulp	1,669,000 tons
Paper	835,000 tons
Paperboard	1,050,000 tons

NO shut down time! stream pollution! scale removal costs!



Conkey 4-Body Triple Effect Flat Plate Heating Surface Evaporator

Conkey Flat Plate Heating Surface Evaporator *with Rosenblad Switching System**

The proven system for avoiding stream pollution by sulphite pulp mill waste liquors that proved so outstandingly successful in commercial installations all over Scandinavia, is now adapted for use in this country by General American. *In every instance* where a Rosenblad Switching System has been installed, shut down time *and* scale removal *costs have been practically eliminated!* The Rosenblad System utilizes the condensate wash as a descaling operation carried on during full capacity operation of the evaporator. Surfaces subjected to boiling liquor are periodically switched with those in contact with vapor and condensate to clean heating surfaces during normal continuous operation. *Every part* of the equipment is switched, consequently scale is washed away from pipe lines, valves and vessels . . . in addition to heating surfaces.

At present in this country . . . Rosenblad Switching Systems in Conkey Flat Plate Heating Surface Evaporators are being constructed for full scale commercial operations. *Write today for detailed bulletin.*

*Patents Applied For

PROCESS EQUIPMENT DIVISION GENERAL AMERICAN TRADE MARK

GENERAL AMERICAN TRANSPORTATION CORPORATION

PROCESS EQUIPMENT DIVISION

Sales Offices: 10 East 49th Street, New York 17, New York
General Offices: 135 South La Salle Street, Chicago 90, Illinois

Sole Licensee in the U. S. A. for the A. B. Rosenblads Patenter Evaporator Switching System

OFFICES IN PRINCIPAL CITIES

Other General American Equipment:
Turbo-Mixers, Filters, Dewaterers, Dryers, Towers, Tanks, Bins, Pressure Vessels

The present production of chlorine is about 6550 tons per day. New facilities nearing completion should increase this amount by 740 tons daily. The greatest part of the chlorine expansion will take place in 1952, bringing into production another 1800 tons daily.

* * *

U. S. Production of sulphur in all forms in 1951 totaled about 6,200,000 long tons. Of this amount, about 5,325,000 tons was brimstone or elemental sulphur from Gulf Coast salt dome deposits, 200,000 tons was limestone recovered from refinery and some natural gases, 400,000 was sulphur in pyrites, and the remainder was sulphur obtained in other forms from smelter gases and other sources. Production in 1950 was about 6,000,000 tons.

Exports of crude sulphur in 1951 amounted to about 1,300,000 long tons.

Of the new sulphur projects the most prominent is that of the new deposit at Garden Island Bay in Louisiana which will be the largest sulphur development anywhere in the world in nearly twenty years. Freeport Sulphur Co. is building a 10–15 million dollar plant with an annual production goal of 500,000 long tons of sulphur. It is expected to be in production by the end of 1953.

The past year marked the start of the development by Texas Gulf Sulphur Co. of a new mine at Spindletop dome near Beaumont, Tex., the beginning of operations by Jefferson Lake Sulphur Co. at its Starks dome in Calcasieu Parish, La., and the start of development of another Louisiana deposit, Bay Ste. Elaine, smaller than Garden Island Bay, which Freeport will mine with an "amphibious" plant. These mines and expansion of an existing mine will increase brimstone output by more than 1,000,000 tons daily, if production plans are realized.

* * *

Expansion of the paper industry in 1952 is expected to be about the normal $3^1/_2\%$ of existing plant. Almost 80% of the planned industry capacity is scheduled for the southern states. Large integrated plants have moved south because of low-cost power, favorable wood supply, and an adequate labor supply. Compared to 1950, planned increase in capacity for the two years ending in 1952, is expected to run 8.1% for the industry as a whole, 7.7% for paper only, and 8.6% for paperboard. The industry is expected to run 96% or 97% of rated capacity throughout 1952.

* * *

To better acquaint the American public with the steps being taken by the forest industry to assure the nation of a perpetual timber supply, Weyerhaeuser Timber Co. will inaugurate a series of national magazine advertisements telling the story of tree farms and wood utilization. These will appear in the *Saturday Evening Post, Farm Journal,* and *U. S. News and World Report.*

* * *

Powell River Co., Ltd. has established a new world record for daily newsprint production. 1049.9 tons were produced in a 24-hour period, breaking a previous record of 1047.7 tons. It has only been two years since Powell River was the first mill to reach 1000 tons per day. With this same equipment, the latest production record has been obtained.

* * *

The new 210-inch Beloit machine which started in January, 1950, at the Crossett Paper Mills, Crossett, Ark., has attained a record-breaking speed of 1925 feet per minute on 30-pound kraft wrapping. The new machine regularly operated between 1700 and 1800 feet per minute on 25 and 30-pound wrapping and bag paper. K. O. Elderkin, Mill Manager and former newsprint main, has spearheaded the developments at Crossett.

* * *

The Midwest Power Conference has been renamed the American Power Conference and will hold its annual meeting at the Sherman Hotel, Chicago, on March 26–28, 1952. R. A. Budenholzer of the Illinois Institute of Technology is Conference Director.

* * *

J. L. Ober, Vice-President of the Scott Paper Co., Chester, Pa., was recently presented the Black Bear Award by the University of Maine. Recipients of this award are selected by an alumni committee in recognition of service in promoting

J. L. Ober (right), Vice-President of Scott Paper Co., Chester, Pa., receiving the Black Bear Award from Professor J. B. Calkin

university spirit. Mr. Ober was a member of the original group that established the U. of M. Pulp and Paper Foundation. The presentation was made at Chester by J. B. Calkin, Director of the U. M. Department of Industrial Cooperation.

* * *

A scholarship amounting to $1600 for four years at Western Michigan College in the Pulp and Paper Department has been established by William Slavin, President of the Hawthorne Paper Co., for the purpose of encouraging local high school graduates to enter the pulp and paper curriculum. The selection of the individual to receive the scholarship is made by competitive examination.

* * *

R. C. Reid has retired as a partner from the firm of Knowles Associates, Chemical, Metallurgical, and Mechanical Engineers, 19 Rector Street, New York 6, N. Y. The remaining partners C. L. Knowles, R. Chelminski, and O. R. Kuster are continuing the business.

* * *

The Association of American Wood Pulp Importers elected the following officers for 1952: President—Albert Blattman; Vice-President—John Westergaard; Secretary—Harold J. Lanney; Treasurer—V. Ramsay, and Director—Stanford G. Blankinship.

* * *

Three men have been appointed to the professional staff of Pulp and Paper Manufacture at the State University College of Forestry, Syracuse, N. Y. Donald W. Libby has succeeded Paul M. Schaffrath who resigned to join the Oxford Paper Co. Harold Jickson, formerly of the St. Regis Paper

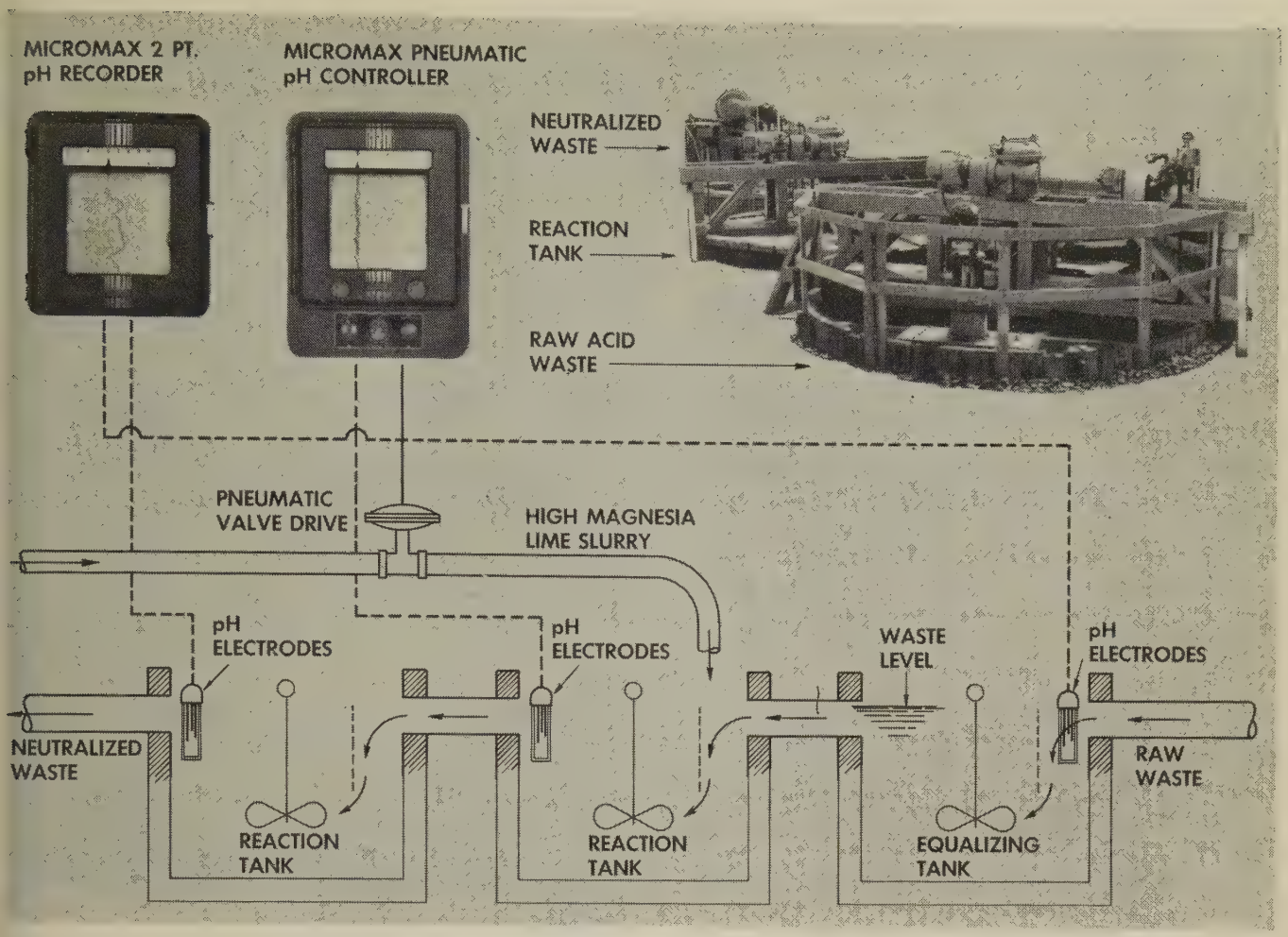


Diagram shows how acid wastes from a typical big plant are neutralized effectively by controlled addition of lime slurry. Micromax instruments automatically regulate lime feed, and record pH of raw and treated wastes.

Want a pH control to fit *your* plant?

One of the country's largest drug and chemical manufacturers faced a waste disposal problem which had some intricate angles. It involved neutralization and disposal. It required better operation of existing equipment. But analysis of the situation, plus correct control, brought the right answer.

First, in cooperation with the plant's engineers, we studied the whole situation. The waste was acid. It varied in quantity. It varied widely in concentration. Waste was to be neutralized by high magnesia lime—relatively slow in rate of reaction. And there were other factors.

After examining these control variables, pH instrumentation recognizing all pertinent facts was arrived at by our proved method of "controllability analysis." This analysis weighed *all* pH control factors—acidity of waste, treating system, reagent. It showed proper arrangement of correct retention capacities. It accurately predetermined the *net control effect.* And the analysis required only a little time.

If, like this firm, you're planning pH control, you can't afford to miss this special service. Write to Leeds & Northrup Co., 4909 Stenton Ave., Philadelphia 44, Pa.

Remember . . . write for Bulletin ND44-96-708 —

This handy booklet shows the many benefits of automatic pH control in "Effective Neutralization of Industrial Wastes." It explains how our controllability analysis works. It even contains a simple questionnaire so we can help you solve your plant's pH problems *now.* Send for a copy.

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

Jrl. Ad ND44-96-708(3)

Co., and Daniel V. Lent, formerly of Western Michigan College, now bring the combined faculty and research staff at the college to 99 individuals.

The College of Forestry has issued an interesting 106-page monograph on Cooperation Forest Fire Control.

* * *

The McLaurin-Jones Co. of Brookfield, Mass., has established a $500 annual scholarship for a student in the Paper Engineering Course at Lowell Textile Institute.

* * *

The Crown Zellerbach Corp., San Francisco, Calif., has issued a 36-page booklet on "Growing Paper on Tree Farms."

* * *

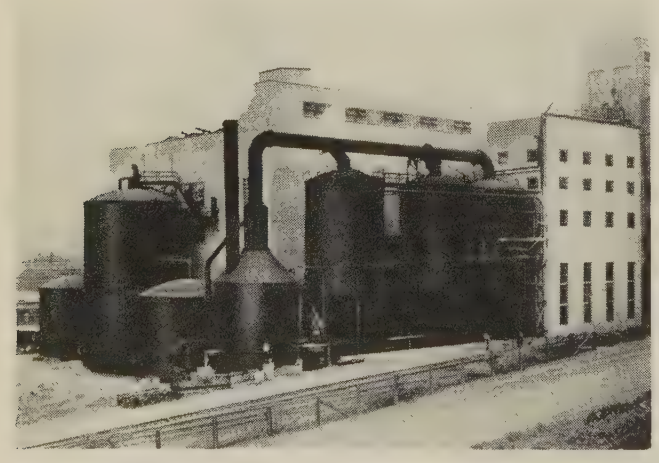
The University of Florida has announced the establishment of the $1000 William H. Brydges Fellowship in Pulp and Paper Research. The funds have been made available by the American Pulp and Paper Mill Superintendents Association through the generosity of the D. J. Murray Mfg. Co., Wausau, Wis. Applicants, who have or expect soon to have a bachelor's degree, should apply if interested to the Director, Engineering and Industrial Experiment Station, University of Florida, Gainesville, Fla.

* * *

Kyle Ward, recently Chief of the Cotton Fiber Division of the Southern Regional Research Laboratory at New Orleans, La., has joined the staff of the Institute of Paper Chemistry, Appleton, Wis., as head of its cellulose group. Most of Dr. Ward's research interests have centered in the field of cellulose and textiles, especially cotton.

* * *

The Rust Engineering Co., Pittsburgh, Pa., reports that its activities in 1951 represented the highest volume in its 47-year business history. In the pulp and paper field work was carried forward on the major expansion project of Hollingsworth & Whitney Co., at Mobile, Ala.; Crossett Paper Mills at Crossett, Ark.; and the West Virginia Pulp & Paper Co. at Covington, Va. The new 150-ton per day soda recovery plant for the New York & Pennsylvania Co. was completed at Johnsonburg, Pa.; and work was under way to double the daily capacity of Bird & Son's Shreveport, La., felt mill. This mill was completed by Ruse in 1950 and provision was made during the construction for this expansion. Also under way was work on the $5,800,000 expansion project of the Halifax Paper Co., at Roanoke Rapids, N. C.



New digester building at the Covington, Va., mill of the West Virginia Pulp & Paper Co., recently completed by the Rust Engineering Co.

The statistics of pulp and paper production in Canada for 1950 have been issued by the Dominion Bureau of Statistics, Industry and Merchandising Division, Forestry Section, Department of Trade and Commerce, Ottawa, Ont., and published in detail in the December, 1951, issue of the *Pulp and Paper Magazine of Canada.*

Since another year will pass before the 1951 statistics will be released by the Dominion Government, the Editor of *Pulp and Paper Magazine of Canada* has appended to the 1950 published report his forecast for 1951. In doing so he has performed a very useful service. His statement is as follows:

"Pulp and paper manufacture became Canada's first billion dollar manufacturing industry early in December, 1951, when the value of the industry's production for the year topped this astounding figure. When preparing this forecast, late in November, it appeared that the total value of our ndustry's production for the current year would be close to $1.1 billion. The total tonnage of products produced for sale during the year will be approximately 9,600,000 tons. The production of papers and paperboards will be of the order of 7,085,000 tons, of this approximately 5,525,000 tons will be newsprint.

"Pulp and paper exports in 1951 will exceed $900,000,000 and represent one quarter of all shipments to other countries, and well over one third of all Canadian exports to the United States.

"Shipments of newsprint to the United States during the year will be close to 4,800,000 tons valued at $500,000,000. Newsprint represents approximately 55% of the total value of the products produced by the pulp and paper industry for the year.

"During the year, 9,200,000 tons of pulp will have been produced, of this approximately 7,000,000 tons will be converted into papers and boards, etc., in Canada and exports of pulp will be in the neighborhood of 2,200,000 tons (valued at $355,000,000).

"The total cords of pulpwood produced during the year will be approximately 16,000,000. It is to be regretted that of this quantity produced, 2,750,000 cords were exported (over 90% to the U.S.A.). This represents 17% of the pulpwood produced during the year and an increase of 62% over the quantity exported in 1950."

* * *

Many a family in the Green Bay, Wis., area is burning an improved fuel this Winter in space heaters, furnaces, and open fireplaces, unaware that it is helping to solve the sulphite pollution problem in Wisconsin streams and at the same time put to work a by-product of the coal docks. The new fuel blocks are the size of a common brick, are practically dustless, produce very little smoke or ash, and have about 25% greater heating value than ordinary coal. They are made by compressing small coal particles after mixing these with sulphite liquor which serves as a binder.

Executives of the F. Hurlbut Co. and the Sulphite Pulp Manufacturers' Research League cooperated to develop this idea. The League has been working on the use of spent sulphite liquor as a binder for other types of coal briquettes. Hurlbut operates a coal dock and also manufactures concrete construction blocks.

In the course of shipment, storage, and rehandling, a good deal of coal gets broken into sizes too small for most home stoves and furnaces to burn. Concrete block making slacks down in the Fall and the crews have to be laid off just about the time when large quantities of coal are required for heating homes. If Hurlbut could find a way to process its fine-sized coals into a product that would keep its men and machinery busy all Winter, this looked like almost the ideal solution of both problems.

The research League, which Wisconsin sulphite pulp manufacturers maintain to find practical ways of keeping spent

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SULPHITE MILLS

Rosenblad Evaporator for Sulphite Spent Liquor.
(U.S. Licensee: General American Transportation Corp.)
Heat and SO_2 Recovery Systems from Relief Gas and Blow Pits.
Indirect Cooking System.
Spiral Plate Heat Exchangers.

KRAFT MILLS

Blowsteam Heat Recovery System.
Spiral Plate Turpentine Condensers.
Spiral Plate Surface Condensers for Evaporators.
Spiral Plate Exchangers for Heat Recovery in Bleaching Plants.

TECHNICAL REPRESENTATIVE AND AGENT FOR:

Markila-Brax Diffuser Washing System.
Sandberg Central Dumping Valves for Diffusers.

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sulphite liquor out of the state's streams, put this idea into its Appleton laboratories for development. Last Summer during the weekends when the concrete block machines would normally be idle, League engineers worked with Hurlbut men to test out their ideas on the full-scale equipment at Green Bay. Eventually they were able to produce fuel blocks of uniformly excellent quality, and their first trial run before Thanksgiving turned out 80 tons in a day.

Ordinary fine coal, a by-product from Hurlbut dock operations, is run through the concrete block-making machinery, along with sulphite liquor which has been concentrated to contain 60% wood solids. This binder is itself an excellent fuel and enriches the coal fines. The concentrated liquor is being supplied from the League's Appleton pilot evaporator plant, which has the only evaporators in Wisconsin capable of handling spent sulphite liquor. The concentrate is produced in the course of League experiments with the evaporation process.

Hurlbut got into full production of the new block fuel early in December and has found a brisk demand for its output. The bricks sell at a lower price than the coarse coal of the same quality.

* * *

The Everett Pulp and Paper Co., Everett, Wash., in its new house organ "Today It's Different" presents the specifications and performance of some of the current makes and models of folding machines used in binderies. These data should be interesting and useful to many readers of *Tappi*. In every modern bindery there are folding machines that are miracles of mechanical ingenuity. Sheets of paper are snatched from the automatic feeder with lightning speed and flip through the fold plates as fast as 4200 inches per minute. That is 13,260 19-inch sheets per hour. These machines not only fold; they score, perforate, slit, and paste. In combination with other equipment for gathering and stitching, today's folding machines turn out America's billions of publications, books, advertising and informational literature, and forms. Below are listed some of the current makes and models.

Baumfolder 14" x 20" Junior Jet. Five folding plates; one, two, three, four, or five parallel folds in one operation. Sixty styles of folds, four to twenty-four pages. Friction feed or Suction-Pile feed. Cuts, scores, perforates.

Baumfolder 17" x 22" Junior Jet. Same performance as above, but with larger sheets.

Baumfolder 17 1/2" x 22 1/2" Senior. Seven folding plates. Two cutting-scoring-perforating units. Folds, pastes, and trims in one operation. One hundred and eight styles of folds, up to forty-eight pages.

Baum 22" x 28" octuplet and decuplet. Four to sixty-four pages; one hundred forty-four styles of folds. Three scoring, perforating, cutting units.

Baumfolder 25" x 38". Thirteen folding plates; four to sixty-four pages. Will fold, paste, trim, and fold again 6000 9 x 12 booklets an hour.

Baumfolder 25" x 38"—50. Nineteen folding plates. One to nine parallel folds followed by right-angle folds in one operation.

Baumfolder 30" x 46"—60. As above, but folds larger sheets.

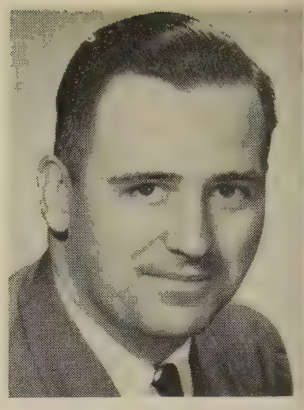
Cleveland 14" x 20" Model W. Five folding plates. Makes one fold; two parallel folds; one fold followed by one, two, or three right-angle folds; two parallel folds followed by two three, or four right-angle folds. Maximum speed 350 feet per minute. Friction or Suction feed. Perforates, scores, and slits.

Cleveland 19" x 25" Model OS. Three folding sections to make sixteen-page signature in three right angles to page size 6 1/4 x 9 1/2. Also makes three folds in parallel section, three in eight-page section, and two in sixteen-page section. Maximum speed 325 feet per minute. Perforates, scores, and slits.

Cleveland 22" x 28" Model OO. Nine folding plates, in three sections. Includes practically every combination of parallel and right-angle folds up to 22 x 28 inches; some types to 22 x 34. Maximum speed 325 feet per minute. Perforates, scores, and slits.

Cleveland 25" x 38" Model M-S. Ten folding plates; four in parallel section, three in eight-page section, and three in sixteen-page section. Maximum speed 325 feet per minute. Perforates, scores, and slits.

A. G. Gibson, The Black-Clawson Co.



Angus J. Gardner, Rice Barton Corp.

Cleveland 28" x 42" Model MM. Takes up to 28 x 52 for parallel fold. Makes one to four parallel folds and two to four right-angle folds. Folds from four to eighty pages; one hundred and fifty different types of folds. Cleveland Air Wheel continuous feeder. Perforates, scores, and slits.

Cleveland 42" x 62" Model KK. Four fold plates in parallel section, four in eight-page section, two in sixteen-page section, and one in thirty-two-page section. Air Wheel continuous feeder. Folds 7800 19 x 25 sheets an hour.

Master 17 1/2" x 22 1/2". Two types and several models. Air feed machines: (1722A) two parallel folds; (1722AR) two parallel, three parallel at right angles; (1722AR-4) two parallel, four parallel at right angles. Friction feed machines: (1722F), (1722FR) and (1722FR-4), capacities as on air feed machines above. Maximum speed four hundred feet a minute. Perforates, scores, and slits.

McAdams "Section" Folder—Norwood 36". A single-fold blade machine for folding large notebooks. Takes up to forty-eight sheets; will fold books after sewing.

* * *

Angus J. Gardner has been appointed Assistant Vice-President in Charge of Sales for Rice Barton Corp., Worcester, Mass. Mr. Gardner was formerly with the International Paper Co. and the Great Northern Paper Co.

* * *

A. G. Gibson has succeeded P. J. Jerardi as Chief Engineer of the Black-Clawson Co., Hamilton, Ohio. Mr. Gibson has been with B-C since 1937.

* * *

Edward McSweeney of Perkins-Goodwin Co., 30 Rockefeller Plaza, New York, N. Y., has issued a very interesting brochure on "The Effect of Government Controls on Business Management." It is an address given at the Chemists Club in New York City.

* * *

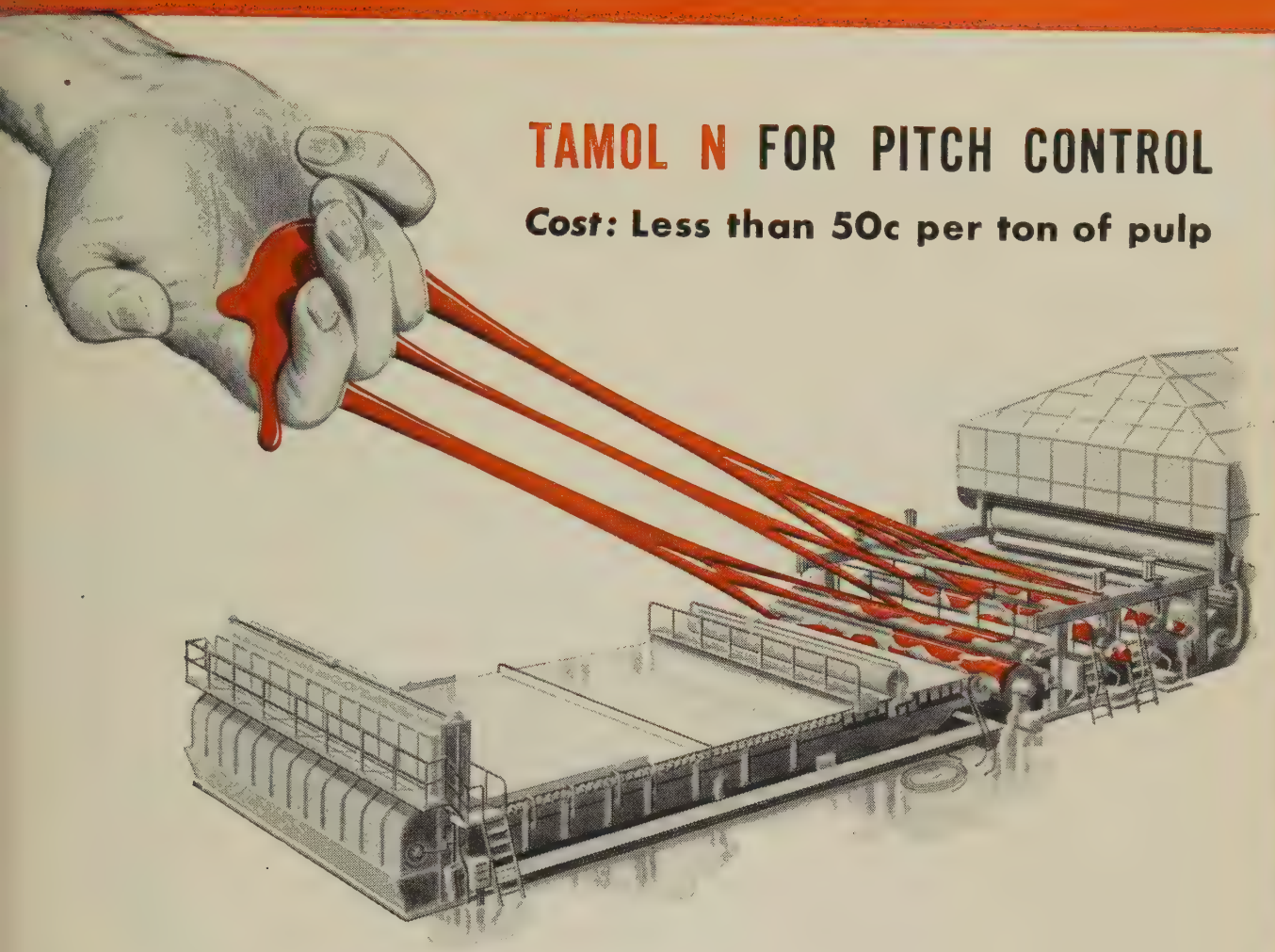
Riley M. Bates of ALD New York, Inc., Long Island City, N. Y., has joined "Print the Magazine of the Graphic Arts" as business and management consultant.

* * *

George S. Herbert has been appointed Assistant General Manager of the Midwest-Fulton Machine Co., Dayton, Ohio, builders of the Fulton Drier Drainage Systems.

* * *

Celgar Development Co. has announced its plan to embark soon on a 65 million dollar wood pulp and newsprint development in the Arrow Lakes region of southeastern British Columbia. Two and possibly four mills will be built near Castlebar, B. C., 250 miles east of Vancouver, B. C., in the West Kootenay area. The company is an affiliate of the Celanese Corp. of America. About 2000 persons will be employed. Details of the development were outlined in



TAMOL N FOR PITCH CONTROL

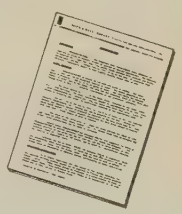
Cost: Less than 50c per ton of pulp

Here's the easy, low-cost way to control pitch, prevent expensive rejects, and eliminate costly shutdowns for cleaning.

Added directly to pulp in the beater, TAMOL N keeps your pitch dispersed in finely divided form. Pitch particles can't clump together to cause spots or holes in paper or to gum the paper machine. And this means fewer rejections and fewer production holdups.

Cost of TAMOL N pitch dispersant is extremely low—usually less than 50c per ton of pulp. Low salt content means added economy—you get what you pay for. If you use alum or clay additions for pitch control, TAMOL will improve their efficiency, too.

Papermakers have known and used TAMOL N for almost 20 years. We'll be glad to send you full details of this time-tested material.



OTHER CHEMICALS FOR THE PAPER INDUSTRY

RHOZYME BB and E-5 Enzymes—for efficient conversion of starch.

UFORMITE Wet-strength Resins—for all furnishes.

TRITON Surface-active Agents—with a score of uses in paper manufacture—in caustic cooking of cotton fiber, as a dispersing agent for pigments and metallic soaps, emulsion-type coatings.

HYDROSULFITE Reducing Agents—for stripping color from rag stock or for bleaching pulp.

HYAMINE Deodorants and Bactericides—for paperboard and glue.

TAMOL, UFORMITE, RHOZYME, TRITON, HYAMINE are trade-marks, Reg. U. S. Pat. Off. and in principal foreign countries.

CHEMICALS FOR INDUSTRY

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

Representatives in principal foreign countries

statements of Harold Blancke, President of Celgar, and E. T. Kenney, Forests Minister of British Columbia.

* * *

Twenty thousand reprints of the remarkable Beloit Iron Works "Imagine America Without Paper" campaign have been distributed. Reprints are available for use on company bulletin boards and letter enclosures. Write the Company at Beloit, Wis.

* * *

The General Dyestuff Corp., 435 Hudson Street, New York 14, N. Y., has issued the following releases of circulars: G-693, Naphthalene Green V Extra Conc. C. F.; G-695, Pigment Green BSA Supra Paste in the Paper Trade; AP-14, Igepon T Gel in the Paper Trade; AP-15, Nekal BX High Conc. for Paper and Pigment Applications and Misc. Uses.

* * *

A coating plant to demonstrate the Trist paper coating system has recently been installed at Worcester, Mass. This plant includes a high-speed coating machine which will coat paper up to $27^1/_2$ inches wide, a Kinetic Hydro Colloider which makes the emulsion coating, and complete laboratory facilities. Paper mills and converters may now have sample rolls of paper coated and representatives of these firms observe the coating operation. Laboratory facilities are provided for the development of coating formulations to be applied to various kinds of board and paper. Demonstrations are arranged by appointment with Trist Colloidal Products Patented, 420 Lexington Avenue, New York 17, N. Y.

* * *

An experimental pipe line about 8000 feet long is now transporting between 7000 and 9000 tons of coal daily near Cadiz, Ohio. The coal is pumped through the $12^3/_4$-inch pipe in the form of slurry of fine coal and water. The line will soon be extended to 17,000 feet. If it is successful, after a year's operation, it is likely to be a forerunner of a network of coal pipe lines to large coal-consuming centers.

* * *

The Electric Eye Equipment Co., 6 West Fairchild Street, Danville, Ill., has issued a circular describing the Hurletrom Automatic Caliper and Wright Control used for maintenance of predetermined caliper and weight in heavy papers and boxboard. The company has installations in at least 11 board mills.

* * *

Tappi would appreciate it if you mention the magazine or the Association when requesting additional information about items mentioned in the Industry Notes or in the advertisements in this magazine. Companies advise us that they receive a large number of inquiries but usually no mention is made regarding the source of the inquiry. All of the trade papers as well as the companies would like to know how you happen to make your inquiries.

* * *

National Starch Products, Inc., is launching a 2,000,000 dollar program to expand its resin activities. The first step in the three-year program will double National's present capacity for producing vinyl acetate polymers and copolymers. Plans have been drawn for construction of a new research building to provide additional facilities that are required for the new program. These resins are used in adhesives formulations, heat-seal coatings, laminating gloss coatings for paper, greaseproof coatings, high-solids lacquers, and protective coatings requiring good adhesion.

* * *

Lauriston C. Marshall has been appointed Director of the new Link-Belt Co., physical testing and research laboratory at Indianapolis. Dr. Marshall has been Professor of Electrical Engineering at the University of California.

* * *

Reliance Electric & Engineering Co. has opened its new $1,800,000 Euclid, Ohio, plant. 425 employees of the Company's engineering, development, research, renewal parts, and tool departments moved into the new facility from the firm's two plants in Cleveland.

* * *

The Noble & Wood Machine Co. of Hoosick Falls, N. Y., leading manufacturer of paper mill machinery, has announced the appointment of Nolan & Twitchell Advertising Agency, Inc., of Albany, N. Y. With this announcement comes word of the launching of an intensive magazine and direct mail campaign. 12 full-page advertisements in 3 colors have been scheduled in each of 6 pulp and paper trade journals. A 4-page world-wide monthly mailing piece in 3 colors will soon supplement present mailings of booklets, releases, and technical literature. The Noble & Wood Machine Co. produces over 40 distinct types of paper mill equipment and machinery. Among these are stock preparation equipment such as beaters, jordans, refiners, pulpers, etc., laboratory equipment such as sheet machines and cycle beaters and fiber board machines.

* * *

Greater paper production because of fewer paper breaks and less "down time" has been accomplished through closer control of tension at the Spring Grove, Pa., plant of the P. H. Glatfelter Co.

The Glatfelter Co., manufacturers of high quality book, writing, bond, and specialty papers, are using the latest improvement in paper machine control, a General Electric paper tensiometer, to control paper tension automatically and continuously as the processing paper races between the calender rolls at hundreds of feet per minute. According to Glatfelter engineers, use of the sensitive device has resulted in fewer paper breaks in the machine, less waste, less down time, and an over-all lowering of production costs.

Paper tension, always difficult to control, has previously been controlled in most plants indirectly by automatic regulation of section motor speed or section motor current.

With the installation of the paper tensiometer as an automatic control with a General Electric electronic amplidyne sectional drive, tension of moving sheet at Glatfelter is held constant regardless of changes in any of the variables affecting tension, such as freeness, consistency, drier temperature, moisture content, calender stack loading, or friction load variations. The tensiometer utilizes only one very short roll and therefore does not complicate the paper threading of Glatfelter's machine.

In operation, the small, 4-inch roller on the tension head rides on top of the moving sheet of paper so that a slight "dimple" is depressed into the sheet. Variations in the sheet tension change the air gap of a magnetic structure inside the device which emits an electrical signal proportional to the paper's tension. This is transmitted through the power unit which contains the metering circuits, indicating instrument, and operator's controls.

According to Glatfelter engineers, the G.E. paper tensiometer gives continuous and accurate indication of tension variations without damage to the sheet, it is easily adjusted and simple to maintain, it can be used for automatic control, and its fast response time permits its use on the highest speed paper machines.

* * *

Walter J. Beaston will succeed Lloyd E. Kelly who retired on February 1 as Manager of the Eastern Sales Div. of the

UNION

The Trade Name for Top Quality

SCREEN PLATES

MEET THE EXACTING DEMANDS OF CANADIAN PULP AND PAPER MILLS

The quality and dependability of UNION Screen Plates are backed by over forty years' experience in satisfying the needs of Canadian pulp and paper mills.

GIVE MAXIMUM PERFORMANCE UNDER ALL CONDITIONS

UNION Screen Plates are made in our own foundry to our own special formula, using the best materials available. Our laboratory-trained experts control all operations, thus ensuring the utmost satisfaction and value in service.

ALL STYLES AND TYPES AVAILABLE

UNION can supply Screen Plates in any style of cut or number of slots per inch; Chromium Plated, Stainless Steel, Cast Bronze, Phosphor Bronze, Inconel and Rolled Copper. Special Plates also made to order.

UNION also manufactures a complete line of Screen Plate accessories.

UNION SCREEN PLATE COMPANY OF CANADA LIMITED

Head Office and Plant: Lennoxville, Que. Sales Offices: Montreal and Toronto.

Du Pont Pigments Dept. in New York City. Mr. Beaston has been a pigments salesman working out the Philadelphia office.

* * *

Foxboro Co., Foxboro, Mass., has issued Bulletin No. 460 on Flow Meters.

* * *

The Brown Instruments Division of Minneapolis-Honeywell Regulator Co., Station 40, Wayne & Windrim Avenues, Philadelphia 44, Pa., has issued the following catalogues: 9300 on Radiamatic pyrometers; 1800 on Adjustable Port Valves; and 1700 on Air Operated Butterfly Valves.

* * *

Magnus Chemical Co., South Avenue, Garwood, N. J., has announced a new type of cleaning compound Magnus 72 said to do a better job than conventional steam cleaners. It is recommended for use wherever steam or vapor cleaning equipment is in service such as around paper mill equipment.

* * *

Branson Instruments, Inc., 436 Fairfield Avenue, Stamford, Conn., has issued a pamphlet on the Audigage Thickness Tester, many of which are now being used in pulp mills to measure the thickness of digester walls in study of their corrosion rate.

* * *

Rogers, Slade, and Hill in its house organ "Management Briefs" makes ten suggestions for a department head or foreman to develop his group and himself. He can:

Help his people to develop speed, facility, accuracy, skill, in the interest of increased earnings, greater pride in their work, greater personal progress.

Give them pride in doing a good job. Praise them for work well done. Be patient with their mistakes and lapses, using them as teaching opportunities.

Take the time and trouble to explain the company's aims, principles and policies, and the ideals of the management. Otherwise your people are working in the dark.

Keep them posted on all matters that might possibly interest them, so that they will feel a sense of "belonging" and an understanding of what is going on in the business.

Teach them the importance of reducing costs, eliminating waste, improving products, bettering service—to keep the company in a favorable competitive position and improve their own job security.

Do everthing possible to stimulate their interest, imagination, ideas, initiative, resourcefulness, curiosity.

When they suggest an idea, adopt it if possible always giving them credit. Or, if the idea cannot be used, explain why not.

Encourage them to try out their ideas in their own work, even to the point of letting them fail occasionally for the education the experience will give them.

In every difficult situation put himself in their place and ask: How would I like to be treated?

Take a deep interest in their personal progress, personal problems, family and home, and the development of their potentialities.

* * *

J. H. King, Vice-President of Babcock & Wilcox Co., has been named head of the reorganized boiler division of the Company and Luke E. Sawyer and Edward A. Livingstone, President and Vice-President of the recently absorbed subsidiary Tulu Co., have been elected Vice-Presidents of B. & W.

* * *

J. C. Barthal has been placed in charge of new products development for the Paper Chemicals Department of the

J. C. Barthel, American Cyanamid Co.

Peter Abel, Sandy Hill Iron & Brass Works

American Cyanamid Co. He was formerly senior chemical engineer at the Company's Stamford Research Laboratories in Stamford, Conn. He is a 1933 graduate of the N. Y. State College of Forestry and was formerly employed by The Institute of Paper Chemistry in Appleton, Wis.

* * *

Peter J. Abel, who became associated with the Sales Engineering Staff of the Sandy Hill Iron & Brass Works in December, brought to the Company 25 years of association with the pulp and paper trade having been associated with the Stickle Steam Specialties Co. of Indianpolis, Ind., since 1926. Mr. Abel will continue to represent Stickle Steam Specialties in the field of paper mill condensate evacuation systems and control systems.

In recognition of his background and experience Mr. Abel was called upon for service in Washington during World War II and in 1943 he became Chief of Industrial Instruments of the War Production Board. Upon release in September, 1945, he returned to Stickle. While with Stickle he has designed drying systems for paper machines, milk machines, and laundries. This experience has also included heating and ventilating systems for mills. Mr. Abel has been a member of TAPPI since 1935 and he has written a number of articles for publication, from which much information has been used for textbooks.

* * *

Sharples Chemicals, Inc., has merged with Pennsylvania Salt Mfg. Co. through an exchange of common stock.

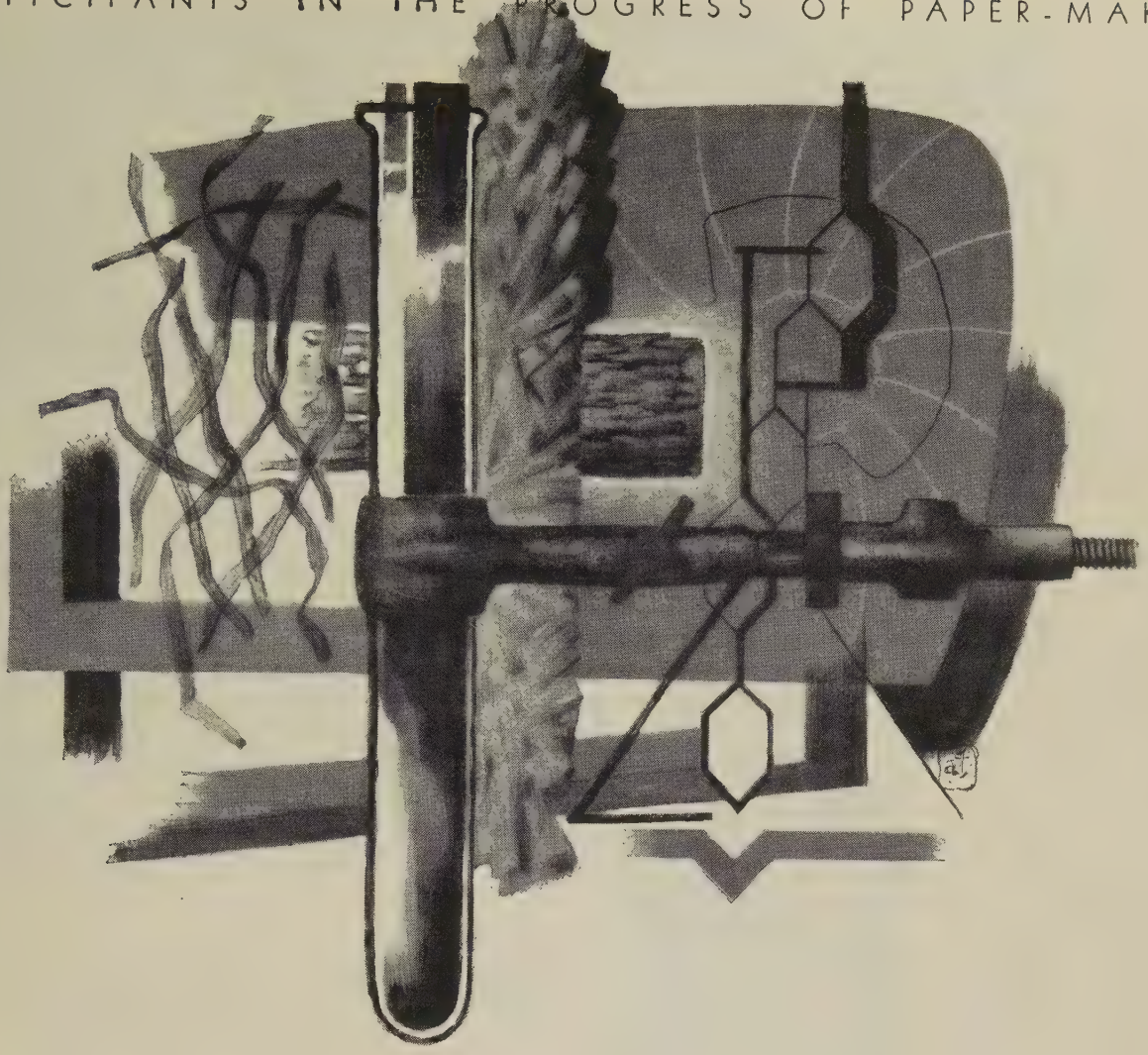
Russell S. Roeller is now General Sales Manager for Pennsalt. Albert H. Clem is Field Sales Manager and Edwin S. Garverich is Manager of Technical Service.

* * *

Appleton Woolen Mills, Appleton, Wis., has announced that Clifford Goldman will represent the Company in Ohio, Indiana, Illinois, Iowa, Missouri, and Kansas and P. H. (Bud) Fields will represent the Company in Arkansas, Tennessee, North and South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas. This territory was formerly covered by S. L. Bittner & Sons, Inc., of Mobile, Ala. Mr. Goldman will live at Vincennes, Ind., and Mr. Fields at Kreole, Miss.

* * *

Paper and Industrial Appliances, Inc., of 122 East 42nd Street, New York, will be known as Pandia, Inc. The name Pandia has come into wide use among the many friends and customers of the Company during the years of its association with the pulp and paper industry. Because of this, the company thought it appropriate for permanent use. Pandia, Inc., is best known for its work in the development of continu-



Chemicals . . . produced by an industry which has made magnificent contributions to paper-making progress through applied research.

Fourdrinier Wires . . . fabricated for 56 years by Appleton Wire Works, Inc., where continuous research — directed toward making a better product—has *earned* the acknowledgment that *"Appleton Wires are Good Wires!"*

APPLETON WIRE WORKS, INCORPORATED • APPLETON, WISCONSIN

ous cooking. It has developed two pieces of equipment for this purpose—the Chemi-Pulper continuous digester and the Morley continuous pulper. It is also recognized for its success in special designs of the Brammer recording consistency control to meet actual mill conditions.

Pandia, Inc., is a change in name only. There will be no change in policy, organization, or management. Officers of the Company are: Audenried Whittemore, President, Leonard G. Durant, Vice-President, and R. G. Goodwin, Director of Sales Engineering. Pandia's equipment is manufactured in the U.S.A. by Pandia, Inc., and in Canada by The Alexander Fleck Ltd., and is sold throughout the world.

Audenried Whittemore *Leonard G. Durant* *R. G. Goodwin*

* * *

George J. Muller of New York has been elected President of Morningstar, Nicol, Inc., 100-year-old manufacturers of starches, dextrines, and adhesives. Joseph Morningstar now becomes Chairman of the Board of Directors.

Mr. Muller, formerly the Executive Vice-President, has been a member of the Board of Directors since 1930. He was born in New York and now makes his home in Southampton, L. I. He began his career with the Morningstar Co. in 1918, and has charge of the production and import business. He is Treasurer of the Tapioca Institute of America, of which he was a founder. He is also a founder of the Adhesives Manufacturers Association of America.

George J. Muller, Morningstar-Nicol, Inc.

Murray Stempel of Chicago, a member of the Board of Directors, has been elected Executive Vice-President in Mr. Muller's place. R. Mayson Foster of New York has been made Treasurer and a member of the Board of Directors.

Founded in 1851 by the late Charles Morningstar, grandfather of Joseph Morningstar, Morningstar, Nicol, Inc., includes subsidiary companies of Paisley Products, Inc., Aroostook Potato Products, Inc., Houlton, Me., and the Park-Leggett-Altman Co. of Minneapolis, Minn. The Morningstar Company is also sole selling agent for the New England Starch Co., Houlton, Me.; Magic Valley Processing Co., Twin Falls, Idaho; and Idaho Products, Jerome, Idaho. The Company maintains sales offices in 20 states. Manufacturing plants are located in New York City, Chicago, Hawthorne, N. J., and Houlton, Me.

* * *

Albert E. Forster has been elected Vice-President of the Hercules Powder Co. Paul Mayfield will succeed him as General Manager of the Naval Stores Dept.

Hercules has issued a new technical booklet on CMC. It gives data on viscosity, compatibility, etc., and includes a bibliography on the subject. It may be obtained on request at the Wilmington, Del., office.

Although Hercules chalked up a higher sales volume in 1951 than in any other year in its history (200,000,000 dollars) its net earnings dropped below the previous year because of tax increases.

M. M. Bixby, Director of Sales for Hercules Powder Co.'s Paper Makers Chemical Department, has announced that C. H. Kent, District Manager at Holyoke, Mass., has assumed the duties of special sales representative in New York and New England. Henry L. Mellen has been named District Manager. Mr. Kent has been associated with the paper industry since 1912.

* * *

Mico Instrument Co., 80 Trowbridge Street, Cambridge, Mass., has issued a bulletin on the Mico Fiber Microtome dealing with film on paper specimens.

* * *

Marshall Sittig has joined the information division of the research laboratories of the Ethyl Corp. at Detroit, Mich. Ethyl Corp. manufactures salt cake for the kraft pulping industry.

* * *

Beloit Iron Works, Beloit, Wis., has received a Certificate of Necessity from the DPA for the expansion of its plant to make paper machinery. $1,691,273 was requested, of which 40% was allowed for accelerated tax amortization.

* * *

R. Burke Morden, President of Morden Machines Co., Portland, Ore., will travel to the TAPPI meeting in New York *via* Central and South America during which time he will inspect 50 Stock-Maker installations in Mexico, Argentina, Brazil, Peru, and Chile.

Dan B. Chapman has been appointed midwest sales representative for the Morden Machines Co. He will be located at Appleton, Wis.

* * *

Hooker Electrochemical Co. has announced a $5,000,000 plant expansion program at Tacoma, Wash.

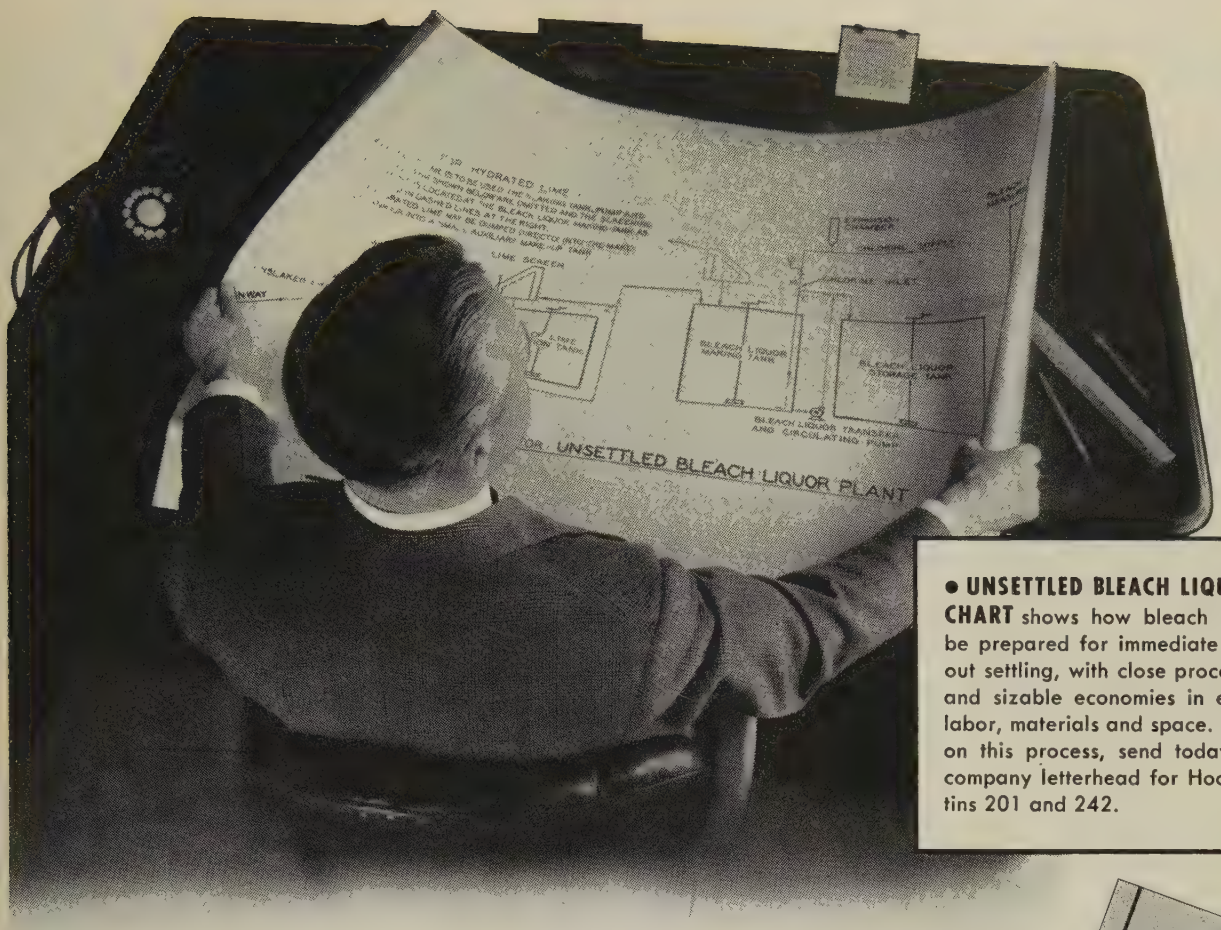
* * *

Monsanto Chemical Co., Merrimac Division, Everett Station, Boston 49, Mass., has issued a new booklet on "Mersize RM." It reports several case studies.

OBITUARY

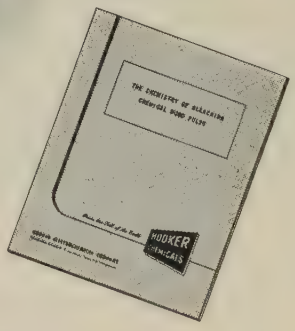
Maurice E. Cody

Maurice E. Cody, Vice-President and General Manager of the Black-Clawson Co., Hamilton, Ohio, died Thursday evening, December 20, at Mercy Hospital, Hamilton, Ohio.



• UNSETTLED BLEACH LIQUOR FLOW CHART shows how bleach liquor can be prepared for immediate use, without settling, with close process control and sizable economies in equipment, labor, materials and space. For details on this process, send today on your company letterhead for Hooker Bulletins 201 and 242.

Helping You Plan for *LOWER BLEACHING COSTS*



Users of the unsettled bleach liquor process developed by Hooker save material costs on tanks required, plus substantial amounts in labor, space, other materials and time.

Hooker Technical Service is part of a "flexible package" that helps you use Hooker Chemicals most effectively and most profitably. It offers assistance on problems of unloading, handling and processing . . . recommendations based on years of experience serving the pulp and paper industry.

Every shipment of Hooker Chlorine and Caustic is carefully checked, product-wise and package-wise, to insure reaching you in proper condition for immediate use. Watchful scheduling and point-to-point checking en route result in deliveries that closely fit your production needs.

Send today, on your business letterhead, for helpful literature on pulp and paper bleaching.

SEND FOR THIS HELPFUL BLEACHING DATA

Bulletin No.	
201	Process and Equipment for Making Bleach Liquor for Use Without Settling
211	Chemistry of Bleaching Chemical Wood Pulps
214	What Do We Know About Bleaching?
236	Importance of pH and Catalysts in Bleaching Operations
242	Production and Use of Unsettled Bleach Liquor
243	Procedures and Brightness Grades in Bleaching Sulfate Pulps

From the Salt of the Earth

HOOKER ELECTROCHEMICAL COMPANY

4704 BUFFALO AVENUE, NIAGARA FALLS, N. Y.

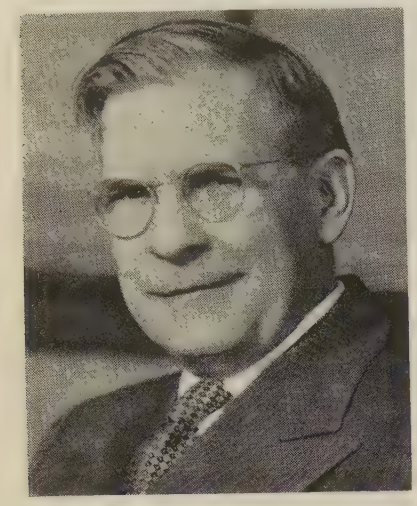
New York, New York • Wilmington, California • Tacoma, Washington

HOOKER CHEMICALS ®

10-1700

SODIUM SULFIDE • SODIUM SULFHYDRATE • SODIUM BENZOATE • CAUSTIC SODA • MURIATIC ACID • PARADICHLOROBENZENE • CHLORINE

Mr. Cody was born in Fort Wayne, Ind., an Aug. 20, 1888, and began his papermaking career with the Fort Wayne Corrugated Paper Co. where he advanced to the position of production manager of the company's five plants. He then became affiliated with the National Paper Board Co. (now Fibreboard Products, Inc.) at Stockton, Calif., as General Manager for two years. The next four years found him at the plant of the Tennessee Extract Co., Nashville, Tenn., where he designed and operated the first mill to make 9-point board from chestnut chips.



M. E. Cody

Mr. Cody became Vice-President and General Manager of the Bogalusa Paper Co. (now Gaylord Container Corp.) at Bogalusa, La., and later held the position of General Manager of the Savannah, Ga., mill of the Union Bag & Paper Corp.

During World War II Mr. Cody served as head of the Paper Section of the War Production Board in Washington, D. C.

He joined the Black-Clawson Co. in May, 1916, as General Manager of the Hamilton, Ohio, Division and was later elected to the position of Vice-President.

He was a Director of the American Box Board Co. at Grand Rapids, Mich.

Mr. Cody is survived by his widow Mrs. Mary Cody; a daughter, Mrs. Claire E. McCarthy of Savannah, Ga.; two sisters in Fort Wayne and two grandchildren.

Burial took place at Fort Wayne, Ind., on Monday, Dec. 24, 1951.

Joseph B. Kindleberger

Joseph B. Kindleberger, Vice-President in Charge of Consumer and Market Research of the Kalamazoo Vegetable Parchment Co., and a director of KVP and of the KVP Co. Ltd., died suddenly in Kalamazoo, Mich., on Thursday evening, January 3. He was the son and only child of the late Jacob Kindleberger, founder of KVP. He is survived by his mother, Mrs. Jacob Kindleberger; by his wife, Helen Price Kindleberger; and by daughters Ruth (Mrs. Robert Knudson) Martha Jo, Lucy, and a grandson. He was born Sept. 22, 1906, at West Carrollton, Ohio.

Joseph B. Kindleberger

He came with KVP Oct. 1, 1925, after a short employment with the Hopper Paper Co., Richmond, Va. He was educated at Central High School in Kalamazoo, and at Babson Institute, Boston. He had lived in the Parchment community since the founding of the company in the Fall of 1909.

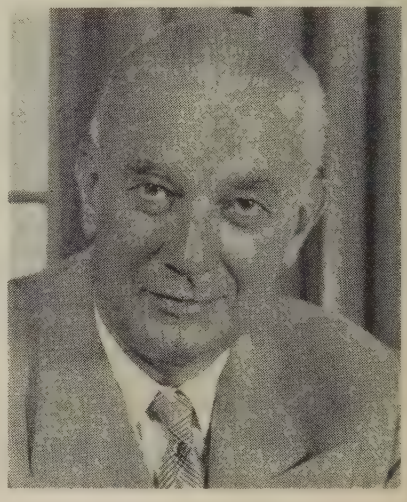
Nearly all of his years with the company were spent in the sales department in many capacities before he became head of the research activities. He was a member of the Exchange Club, a past-president of the Executives Club, a past-president of the Parchment school board, and a member of the Parchment Union Methodist church.

Raymond C. Gaugler

Raymond C. Gaugler, the President of American Cyanamid Co., died on Jan. 11, 1952. The 59-year-old executive suffered a cerebral hemorrhage early on January 10 at his home in Larchmont, N. Y., and died at 12:30 a.m., January 11, at the New Rochelle Hospital.

He is survived by his wife, Eva Lord Gaugler, four daughters, Mrs. Frank Stevens, Jr., Weston, Mass., Mrs. Richard C. Arnold, Mamaroneck, N. Y., Mrs. Lewis Wardell, Jr., Noroton Heights, Conn., Mrs. Joseph V. Hogue, New York City, and thirteen grandchildren.

Born in Pittsburgh, Pa., Mr. Gaugler received his education at parochial schools in that city and at Duquesne University.



Raymond C. Gaugler

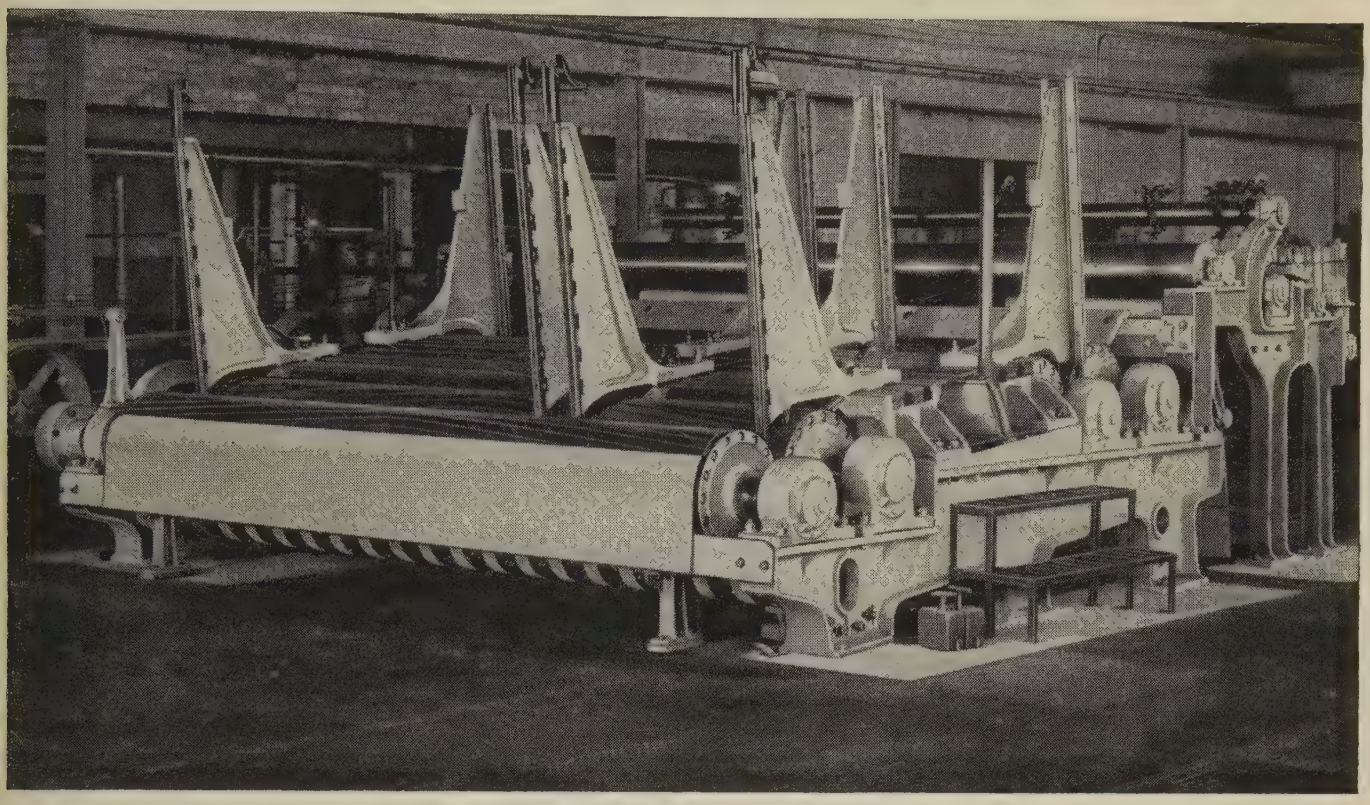
Before joining the Cyanamid organization, he was with the United States Aluminum Co. in New Kensington, Pa., and the Northern Aluminum Co., Shawinigan Falls, Canada. Mr. Gaugler, who had been with Cyanamid since 1917, served as Assistant Treasurer and Comptroller, and was named Treasurer in 1929. In 1939, he became Vice-President in Charge of Finance; in 1947, Executive Vice-President. He was elected President on Jan. 5, 1951, succeeding the late W. B. Bell. Mr. Gaugler had been a Director of Cyanamid since 1929.

During his many years with Cyanamid, Mr. Gaugler played a most important part in the broad diversification program, including the great strides made in recent years in the field of pharmaceuticals, biologicals, and antibiotics, which has brought the Company to a position of leadership in the chemical and drug industry.

Mr. Gaugler was a Director of several companies associated with American Cyanamid Co. These include Jefferson Chemical Co., Inc., jointly owned with The Texas Co.; Southern Minerals Corp., Southern Petroleum Corp., and Southern Pipe Line Corp., all jointly owned with the Pittsburgh Plate Glass Co. He was also a Director of several Cyanamid subsidiaries, including North American Cyanamid Ltd., Chemical Construction Corp., Davis & Geck, Inc., and The Berbice Co., Ltd.

In addition to his company activities, Mr. Gaugler was a Director of The Guaranty Trust Co. of New York. He was also a Vice-President, member of the Executive Committee, and Director of The Manufacturing Chemists Association. He was active in the affairs of The National Industrial Conference Board. His clubs include The Winged Foot Golf Club of Mamaroneck, N. Y., Larchmont Shore Club, The Union League Club of New York, and The Blind Brook Club of Port Chester.

NEW MOORE & WHITE 4-DRUM WINDER



HERE is an expertly engineered and precision-built *heavy-duty* 4-drum board winder—fast, efficient and dependable to fit the tempo of today's demands and operations. It is operated by a Moore & White mechanical drive, and all moving parts run in anti-friction bearings. It is equipped with M & W shear-cut slitters to insure clean edges to the rolls.

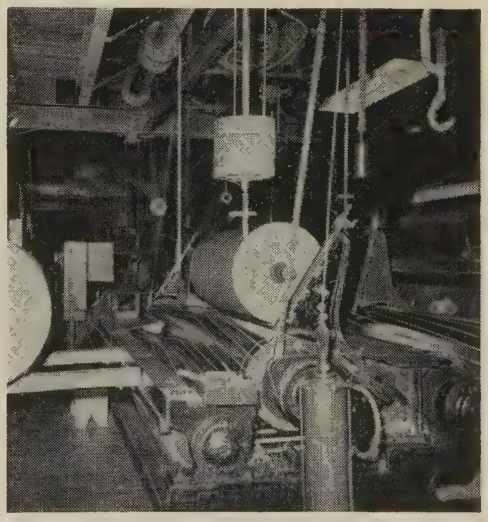
This new Moore & White winder will wind rolls up to 84 inches in diameter. It is available in widths up to the maximum requirements of modern paperboard mills. We can equip it with automatic roll ejectors which permit the completed rolls to be quickly and easily removed from the winder drums without being tended or handled by an overhead crane.

Write or call us today for more detailed information. Our sales engineers will make a prompt survey of your requirements and oversee the installation of the Moore & White winder or other equipment you need for faster, more trouble-free and more profitable operation.

The MOORE & WHITE Company
15th STREET & LEHIGH AVENUE · PHILADELPHIA 32, PA.

Represented on the West Coast by Dan E. Charles Agency, 618 Jones Building, 1331 Third Avenue, Seattle 1, Wash.

Above—*Moore & White 4-drum board winder equipped with Moore & White shear-cut slitters*



Above—*Moore & White 4-drum winder equipped with automatic roll ejectors*

CUSTOM-BUILT MACHINES FOR MAKERS OF PAPER AND PAPERBOARD

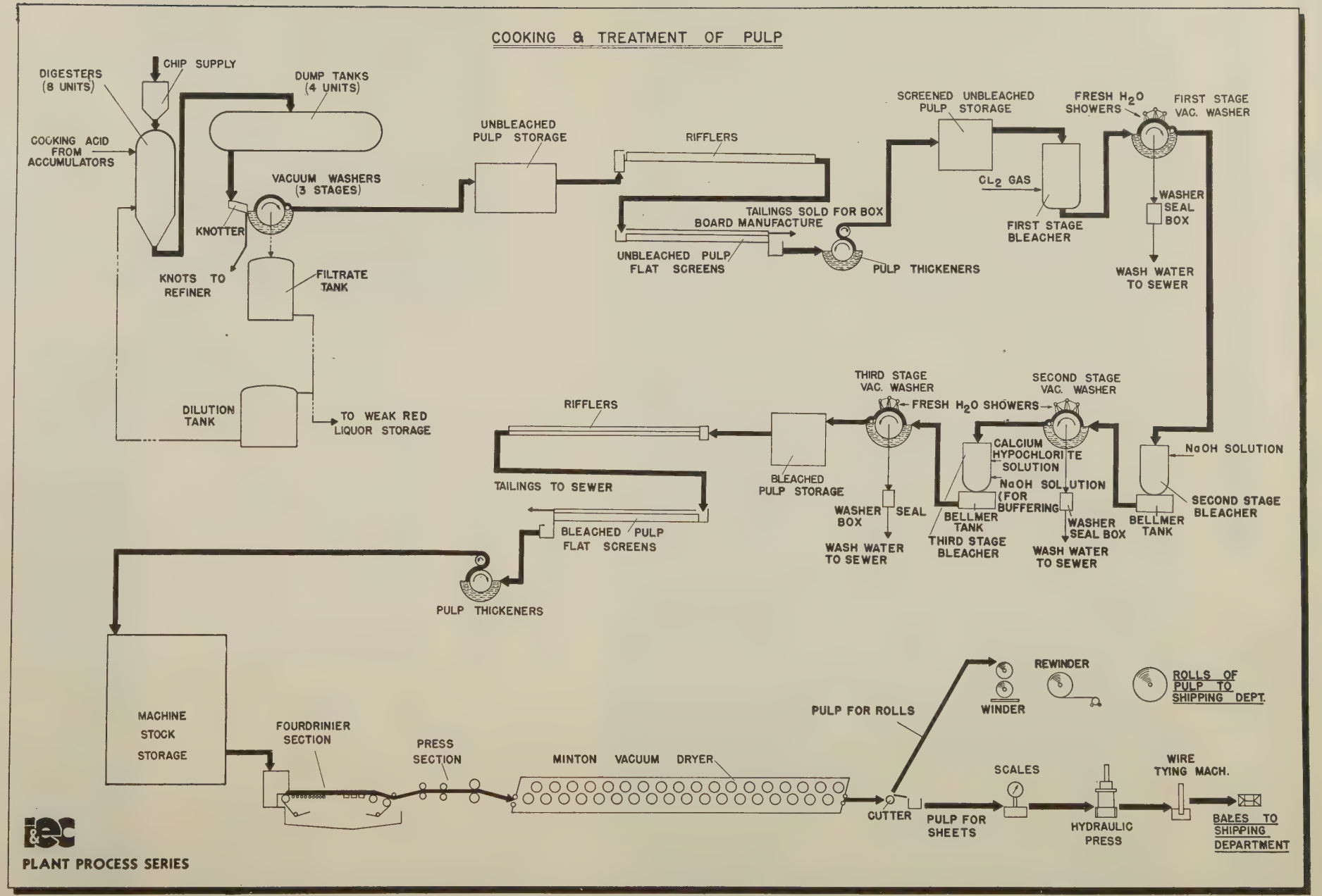


Fig. 1. Flow sheet for the cooking and treatment of pulp at the Longview, Wash., mill of the Weyerhaeuser Timber Co.

Correction

In the January, 1952, issue Fig. 1 (page 32 A) of the paper "Magnesium-Base Sulphite Pulping" is in error due to a switch in plates. The proper flow sheet is on the opposite page, 78 A.

LETTERS TO THE EDITOR

Dedication of Austrian Mill

To the Editor of *Tappi:*

I have just returned from another brief but exhausting whirlwind trip over a good portion of Western Europe, visiting our various Marshall Plan Missions.

During the time I was in Austria, one of the projects was completed and I was called upon to give the feature speech in an official opening ceremony. The mill was the Board and Carton mill of the Mayr-Melnhof Co., in Frohnleiten, Styria, Austria. This company had been producing about 20 tons of high quality folding board per day before this expansion and modernization program was begun. This was not even enough to satisfy the domestic requirements, and in addition the company had demands for exports to the Middle East, the Far East, South America, and to other countries in Europe. Because of these excellent market prospects, combined with availability of raw materials, power, and labor, a project was proposed for installation of a new 110 inch, 5-cylinder Beloit board machine, with auxiliary equipment, including a wastepaper treating and cleaning plant, stock preparation, and refining equipment, etc.

Although the initial mill layout work and choice of equipment appeared to be very sound technically, it was ECA's desire that they take full advantage of all recent development in the U. S. Accordingly, arrangements were made to have an American paperboard expert, Dr. James Harrison of the Michigan Carton Co., go to Austria to make a careful on-the-spot analysis of the project and to give the Mayr-Melnhof staff the benefit of his experience in the board industry. After his recommendations were incorporated in the project in the Summer of 1950, it was given ECA approval and got under way immediately. At this same time two other top flight American production experts also went to Austria under auspices of ECA to analyze the various projects and give technical advice. These were K. O. Elderkin, General Manager, Crosett Paper Mill, and Vance Edwardes, well-known pulp and paper consultant. This three-man team made an outstanding contribution to the Austrian industry.

This machine is now capable of producing 40 tons of folding grades of board per day. However, by adding two additional cylinders and additional driers, it can be expanded to produce as much as 110 tons per day. Total cost of the project amounted to $1,200,000, of which direct ECA aid amounting to $580,000 was furnished for purchase of U. S. equipment. This, of course, was not in the form of a gift to the company, but in the form of an Austrian Schilling loan from the Marshall Plan counterpart funds.

Future plans of the Mayr-Melnhof Co. call for installation of equipment for production of 30 tons of hardwood semi-chemical pulp per day and 30 tons of mechanical pulp per day. These raw materials will be combined with wastepaper and long-fibered chemical pulp for production of a great variety of grades of high quality boards and cartons.

In addition to the time spent in Austria, I also made brief stops in Germany, Italy, France, Holland, and England, where I tried to get some idea of recent activities in the industry in each of those countries. I found that all of them are having great difficulties with the limited raw material supplies; mainly pulpwood, wood pulp, and coal. Of course, the softwood pulpwood shortage will continue to be the limiting factor in production in most of the European countries. Their only hope of alleviating this situation is by greatly increased use of other fibrous materials such as straw, esparto, wastepaper, and fast growing hardwoods. I found that all of the countries visited were making every effort possible toward developing the use of these other fibers to increase their pulp availabilities. They are using them to a much greater extent than before the war. For example, in Holland 42% of the paper consumed is being collected as wastepaper which is higher than any other country has ever reported.

In regard to sulphur, as you know, most of the sulphite pulp industry in Europe uses pyrites. However, those few mills which do not use elemental sulphur have been hit hard on costs. In Austria, some mills were paying as much as $200 to $250 per ton for Greek and Italian sulphur, and even then they couldn't get as much as they needed. You can well imagine that all of the mills are converting over to burning pyrites just as rapidly as they can install the necessary equipment. Most of them are using pyrites burners built by Luigi in Frankfurt, Germany, which they claim are highly efficient.

Joseph E. Atchison
Chief, Pulp and Paper Branch
Economic Cooperation Administration

Ed. Note: Following are the remarks made by Mr. Atchison at the opening ceremony for the new paperboard machine at Karton-und Papenfabrik Mayr-Melnhof & Co., Frohnleiten, Styria, Austria, on Nov. 14, 1951.

One of the Men Behind Eastwood Wires

Patrick Edward Daley

"Ambassador" to NEW JERSEY — PENNSYLVANIA — DELAWARE
MARYLAND — VIRGINIA — OHIO

You know him better as "Pat" Daley, one of our able field men. Though his territory is defined, there are no limits on his wide friendship, his unfailing good nature or his knowledge of the paper field—the last acquired through service in mills that belong in the paper industry's "Who's Who", including production of ground wood specialties, kraft and bag papers, newsprint and other specialties. His long experience in supervisory capacities in both large and small mills has helped us to serve the paper industry better since he joined us in 1935. We are happy to acknowledge his valuable services.

EASTWOOD-NEALLEY CORPORATION • Belleville, N. J.

"It is my sincere pleasure to be here in Styria again and to visit many of my old friends in the pulp and paper industry. I am particularly pleased that the Mayr-Melnhof Co. has invited me to participate in this important occasion. The opening of this magnificent new paperboard machine is an event which should fill us all with pride.

"On behalf of the Economic Cooperation Administration of the United States of America I should like to tell you that we are pleased to have played a part in development of this excellent project. We have great faith in its immediate success. It is our sincere feeling that the entire pulp and paper industry of Austria has an opportunity to achieve a future success far greater than you have dreamed of in the past.

"I know that all of you who are connected with this industry will play an important part in this future, and I know that you all share my optimism about it.

"As I drive over the beautiful Austrian countryside, I see huge forests and sparkling, fast moving streams which furnish the raw material and the power for your industry. As I visit the various mills, I see unmistakable evidence that many highly skilled workers are available to convert these raw materials into finished products, if they are given the tools. Then it remains for the managers and the technical experts to provide the tools for this man power so that they can produce from these raw materials the greatest amount of products, the highest quality products, and at the lowest possible cost.

"If this is done, and I believe that it is being done here, then the Austrian pulp and paper industry can stand on its own in competition with any country in the world.

"As I have visited the various mills in Upper Austria, in Carinthia, and now in Styria, I am impressed with the tremendous amount of progress which has been made since I was here sixteen months ago. The large industry-wide investment program which is now under way is an important step in the right direction. I am proud that the Marshall Plan is playing a major part in financing this program.

"This mill is an example of what can be done and what is being done by cooperation of Austrian industry, the Austrian Government, and the Marshall Plan. I must point out, however, that this is only a beginning. Much more will have to be done year after year by private financing, if Austria is to maintain its rightful position in the pulp and paper markets of the world. No paper mill can remain static and survive. It must progress or perish. I have faith that the Austrian mills will continue to progress.

"The ECA is doing everything possible to assist the pulp and paper industry of Austria in its program of modernization and rationalization. We are doing this by giving financial assistance to the maximum extent and by furnishing technical assistance where it is needed. Again, however, I should like to emphasize that we merely give *assistance* and make no attempt to do the whole job. The really important part of this job is up to all of you, to you who cut the wood in the forest, to you who haul it to the mills, to you who keep the machines running day after day, and to you managers and technical men who are responsible for the planning and the direction of the over-all operations.

"Completion of such projects as this are possible only through the wholehearted cooperation of all of you working together as a well-coordinated team.

"At the present time, Western Europe is faced with a serious shortage of pulp, paper, and paperboard, and the raw materials to produce these vital commodities. Austria is one of the few countries in Europe which has adequate forest resources to supply the pulpwood necessary to support a large industry. As a result, many other countries are looking toward Austria for large quantities of future supplies.

"A rapid expansion in the use of paperboard packaging is now under way all over the world. This expansion can continue only if mills such as this one can turn out large quantities of high quality board at reasonable prices. I am certain that Mayr-Melnhof will play and even increasing role in supporting this expansion.

"You have the raw material, you have the power, you have the skilled man power, and you have the leadership. By your continued cooperation, you should go forward rapidly, always striving for increased efficiency, greater productivity per man, and improvement in the quality of your products. With such progressive efforts you are certain to become one of the leaders in the European paperboard packaging industry.

"We in the ECA salute you in these efforts and wish you the best toward even greater success.

"I now take great pleasure in opening this new paperboard machine and starting it on its way to new production records. May it always furnish jobs for the workers of Styria, may it always furnish paperboard for the world's markets, and may its operation always support the economy of Austria."

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TAPPI DIVISIONS AND COMMITTEES

Recent Reports of Activities

ASTM-TAPPI Joint Committee on Container Testing

Last April at Atlantic City there was formed, by unanimous consent of the Advisory Committee of Committee D-10 of the American Society for Testing Materials and the Advisory Board of TAPPI Container Testing Committee, a joint committee formed for the purpose of screening all proposed projects falling within the scope of either of these two committees. In this way, duplication of work is eliminated and a project emanating from either committee can be so developed that it will be suitable to fit within the scope of both committees.

As an example of this, the ASTM Committee D-10 worked out a proposed standard for testing pallets. The entire program was instigated by the Navy who at the time that the test methods were first proposed, thought only in terms of wooden pallets and skids. There was the possible thought that anything that applied to wood would also serve for steel.

As the proposed standard developed, wording of test procedures was so devised that it would include all pallets including the newer paper pallets.

When the test procedure is in final form it will go to TAPPI for consideration as a test procedure in which TAPPI's only interest is in the test procedure for paper pallets. When the final test procedures have been accepted by both organizations as standard there will be definite uniformity in method and all possible angles will be covered.

Since all members of the Joint ASTM-TAPPI Committee on Shipping Containers have been, in the past, and are now members of both committees, the utmost cooperation is expected.

Those members representing the TAPPI Container Testing Committee are Charles Krebs, F. D. Long, C. S. Macnair, and H. T. Scordas. Those representing ASTM Committee D-10 are H. A. Bergstrom, T. A. Carlso, A. V. Grundy and Earl R. Stivers. Earl R. Stivers was elected Chairman and C. S. Macnair was elected Secretary.

C. S. Macnair, *Secretary*
ASTM-TAPPI *Joint Committee on Container Testing*

Report of Standards Committee for 1951

According to the 1951 Year Book there were (as of Dec. 1, 1950) 2607 individual members of TAPPI in the United States. In the Testing Division there were ten TAPPI committees with a total membership of 148. In other divisions there are at least seven committees with a total of 79 members which are or should be concerned to some degree with the Standards and testing methods of the Association. In other words, disregarding duplication, about one TAPPI member out of every eleven living in the United States belongs to a committee whose scope includes the development of new standards and the review and revision of existing standards. On paper this line-up is impressive, but the record of results accomplished in recent years leaves considerable to be desired. During the past five years (1947–51) only 15 new standards and methods and 13 revisions have been completed. It is realized that the field for new standards is steadily narrowing, but the committees seem to be giving little attention to review and revision of the many old standards previously published. A summary of these, tabulated in Appendix B, shows that 127 have not been revised for over 5 years, 65 for over 10 years, 41 for over 15 years, and *two for 25 years*. It does not follow that all these need revision, but under the present setup there appears to be no readily available way of separating the sheep from the goats.

Another obstacle to successful work on standards is inertia and lack of follow-through. At least five methods (T 213 m, T 226 m, T 437 m, T 445 sm, and T 462 m) were under revision in 1947 but the work on them has not yet been completed. It is not uncommon to have an important letter go unanswered for one to six months. Committee work is the lifeblood of TAPPI. It is a privilege to serve on a TAPPI committee, and those who accept such appointments, particularly the chairmen, should carry on the work with the same business principles and courtesies as they employ in their regular work.

New and Revised Standards

During 1951 one new Tentative Standard and three new Suggested Methods were approved and submitted to the Secretary for publication:

T 480 m-51.	Specular Gloss of Paper at 75° (*1*).
T 636 sm-51.	Oil Content of Petroleum Waxes (*2*).
T 1001 sm-51.	Forming Structural-Type Boards for Physical Tests of Pulp (*3*).
T 1002 sm-51.	Standard Drainage Time of Pulp for Insulating Board (*4*).

Revisions of two Official Standards were approved and published:

T 424 m-45.	Gloss of Paper (*5*).
E 400 s-43.	Specification for Chromium-Nickel-Iron Alloy Castings for Sulphite Pulp Processing Equipment (*6*).

The title of T 424 m was changed to Contrast Gloss of Paper at 57.5°. These two will be submitted to letter ballot of the TAPPI membership for ratification. Notice for the ballot was sent to the New York office in July but there has been a delay in getting it out.

A revision of Official Standard T 9 m-45, Holocellulose in Wood, previously published (*7*) was approved by letter ballot of the membership in May.

Tentative Standard T 221 m-50, Drainage Time and Drainage Factor of Pulp, was also advanced to an Official Standard in May.

About a year ago a proposed method for Water Vapor Permeability of Packages was submitted by the Packaging Materials Testing Committee. It was returned for further editing and clarification and has not yet been resubmitted.

Contents of Book of Standards

Last July the manuscript for the annual printing of Looseleaf Standards was sent to the New York office, but for the third successive year there has been a long delay in the printing. It is hoped that the mailing will be sent out early in 1952. It will consist of:

2 new Suggested Methods.
1 new Tentative Standard.
1 Suggested Method advanced to Tentative Standard.

2 Tentative Standards advanced to Official.
2 revised Standards.
5 corrected Standards.

When the above are included, the manual will consist of the following:

	Tentative	*Official*	*Total*
Standard recommended practices	2	11	13
Standard specifications	4	1	5
Standard testing methods	44	114	158
Suggested methods	..	...	15
	50	126	191

Jurisdiction of Committees

The new standards and methods published during the year are under the jurisdiction of the following committees:

Optical Properties Committee..... T 480 m
Structural Fibrous Materials Committee..... T 1001 sm, T 1002 sm
Wax Testing Committee..... T 636 sm

Change in Committee Personnel

Wilder Chapman resigned from the Standards Committee in August on account of ill health. He has been for a number of years one of the most prompt and efficient members of the Committee. We wish him a speedy recovery. William R. Willets of the Titanium Pigment Corp. was appointed in his place.

Some Suggestions

For the past several years we have emphasized in our annual reports the necessity of reviewing old standards and bringing them up to date as well as offered suggestions for improving the over-all picture of TAPPI Standards. There has been little or no evidence, however, that these have been taken seriously. Unless we are willing to adopt an attitude of laissez faire and accept the lackadaisical lassitude into which some of the committees appear to have lapsed, it will be necessary to take some positive action to prevent still further worsening of the situation. The setup appears excellent—on paper—and there are carefully worked-out rules and regulations—on paper—, but implementation and follow-up are in many cases lacking. In the hope of overcoming some of the difficulties, the following suggestions are offered for the earnest consideration of the Executive Committee:

1. Each committee having to do with standards should present to the Secretary, through the Divisional Chairman, before the Annual Meeting a brief report of progress made during the preceding calendar year. If a committee fails to do this for two successive years, its chairman should be replaced.

2. Each committee should, if possible, hold at least one meeting a year, preferably during the Annual Meeting. In any event, the agenda for the coming year should be presented to the Secretary (through the Divisional Chairman) within 30 days after the Annual Meeting. Accompanying the agenda should be a list of new projects on which the committee proposes to work. Each of these, if approved, should be assigned a new project number and published in the next *Year Book*, together with the year of approval of each project.

3. All Standards and Suggested Methods over 5 years old should be reviewed as soon as possible by the sponsoring committee. Those which the committee decides do not need any major revision should be designated as "reapproved" and such action should be communicated to the Chairman of the Standards Committee together with any changes in wording that may be recommended. Each Standard which requires re-

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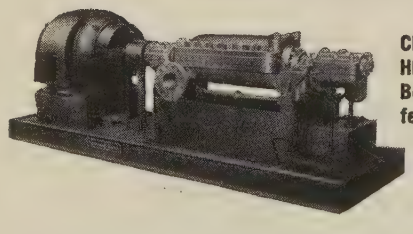
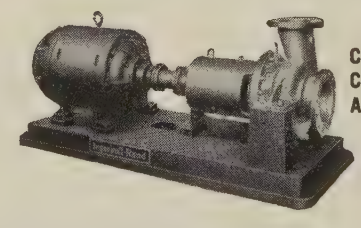
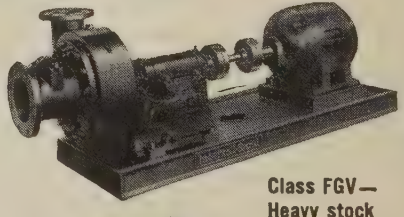


Class HMTA—Boiler feed



Class CSFL—Acid



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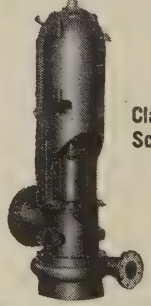
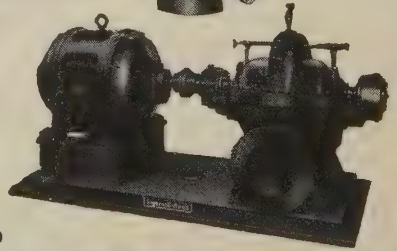


Class VGV—Screened stock

Class ALV—White water and general service



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vision should go on the Committee's list of projects and be assigned a new project number.

4. On all letter ballots a deadline should be set for replies. This might vary for different committees, but well ahead of the deadline a systematic follow-up of delinquent replies should be made. *Members who consistently fail to meet the deadline should be dropped.*

5. Since committee chairmen serve voluntarily and are picked for their technical knowledge and experience, they should not be burdened with excessive mechanical details. Much of this could be handled by the New York office.

6. The fact that committee work is voluntary has led to the attitude in some places not to "look a gift horse in the mouth." Nevertheless, even a gift horse likes a lump of sugar and it might be well to consider an annual award or citation from the top brass for outstanding committee work on standards.

7. It can be assumed that committee personnel working on Standards are both able and willing; the problem seems to be to convert good intentions into action, and within a reasonable time. It is suggested therefore that someone at the New York office be delegated to expedite and give a high priority to work having to do with Standards, especially along the following lines:

(a) Keep an accurate and up-to-date record of committee projects and follow up those which seem to be lagging. Check the project list systematically against committee reports and agenda.

(b) Keep the Standards Committee advised of new as well as completed projects. (The only list of available committee projects at present is in the *Year Book*. This is by no means complete and soon becomes obsolete.)

(c) Assist the committee chairmen by sending out letter ballots promptly, and possibly by handling other types of correspondence.

(d) See that new or revised Standards are published promptly in *Tappi* and that the annual mailing of Standards printed for the looseleaf manual is issued not later than December.

Some of these suggestions may already be covered in the *Year Book*. If so, they are being largely disregarded and more administrative encouragement and follow-through are needed from the upper regions. A successful university needs not only an able faculty, but also a suitable curriculum planned and administered to a definite schedule.

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4. *Tappi* 34, No. 7: 120A (July, 1951).
5. *Tappi* 34, No. 2: 86A (Feb., 1951).
6. *Tappi* 34, No. 6: 118A (June, 1951).
7. *Tappi* 33, No. 9: 100A (Sept., 1950).

ROGER C. GRIFFIN,
Chairman
TAPPI Standards Committee

APPENDIX A

TAPPI Committees Concerned with Standards (As of Dec. 1, 1950)

Testing Division:	Members	
Fibrous Materials Testing	9	
Nonfibrous Materials Testing	26	
Wax Testing	15	
Pulp Testing	10	
Optical Properties	6	
Microscopy	8	
Paper Testing	15	
Container Testing	12	
Packaging Materials Testing	19	
Chemical Methods	28	148

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Research Development Division:
Microbiological 11
Water 11
Fibrous Agricultural Residues 6
Structural Fibrous Materials 27
Converting and Consuming Division:
Wet Strength 5
Plastics 9
Pulp Manufacture Division:
Chemical Products ..... 10 — 79
Total 227

APPENDIX B

Standards & Methods over 5 years old.

The following Standards and Suggested Methods have not been reviewed or revised for over 5 years:

	Totals
6 Years (1945) T 11 m, T 12 m, T 13 m, T 229 m, T 410 m, T 421 m, T 451 m, T 468 m, T 469 m, T 611 m, T 627 m, T 804 m	12
7 Years (1944) E 600 s, T 400 m, T 403 m, T 429 m, T 433 m, T 448 m, T 450 m, T 464 m, T 465 sm, T 620 m, T 623 m, T 624 m, T 625 m, T 801 sm, T 802 m, T 803 m	16
8 Years (1943) E 2 p, T 2 m, T 200 m, T 209 m, T 222 m, T 224 sm, T 225 sm, T 226 sm, T 427 m, T 437 m, T 462 m, T 463 m, T 626 sm, T 628 m	14
9 Years (1942) T 202 m, T 214 m, T 215 m, T 401 m, T 407 m, T 412 m, T 430 m, T 435 m, T 440, T 447 m, T 454 m, T 455 sm, T 459 m, T 622 m	14
10 Years (1941) T 9 m, T 400 m, T 404 m, T 406 m, T 423 m, T 444 m	6
11 Years (1940) M 400 p, O 404 p, T 216 m, T 405 m, T 413 m, T 415 m, T 428 m, T 441 m, T 442 m	9
12 Years (1939) T 213 m, T 419 m, T 445 sm	3
13 Years (1938) T 205 m	1
14 Years (1937) O 401 p, O 402 p, T 8 sm, T 438 m, T 439 m	5
15 Years (1936) O 400 p, T 5 m, T 6m, T 210 m, T 426 m, T 436 m	6
16 Years (1935) T 206 m, T 425 m, T 434 m, T 619 m, T 621 m	5
17 Years (1934) E 1 p, E 201 p, E 202 p, T 3 m, T 4 m, T 208 m, T 211 m, T 212 m, T 411 m, T 431 m, T 432 m, T 616 m, T 617 m, T 618 m	14
18 Years (1933) T 1 m, T 204 m, T 207 m, T 600 m, T 601 m, T 602 m, T 603 m, T 604 m, T 605 m, T 606 m, T 607 m, T 608 m, T 609 m, T 610 m, T 612 m, T 613 m, T 614 m, T 615 m	18
19 Years (1932) E 200 p, T 203 m	2
25 Years (1926) T 409 m, T 417 m	2

LOCAL SECTION ACTIVITIES

Reports of Meetings, Personnel, and Events

Ohio

The Ohio Section met at the Battelle Memorial Institute, Columbus, Ohio, on Dec. 11, 1951. 140 persons, including approximately 20 guests from the Lake Erie section, were present. During the afternoon, prior to the meeting, inspection trips through the Institute and the Pollack Paper Co. Mill in Columbus were made. Walter Johnson of the Pollack Paper Co. was the program committee member responsible for the arrangements for this meeting.

Following the dinner in the Institute cafeteria, Richard Anderson, Assistant to the Director of Battelle, spoke briefly on the history and work of the Institute.

Lewis E. Walkup of the Battelle Memorial Institute was the speaker for the evening. His lecture and demonstrations were on the subject of static electricity. He briefly reviewed the elements of static electricity and the mechanisms of static generation and methods of static elimination were explained and demonstrated. It was shown that static changes on paper can be generated in two ways: (1) by contact electrification, and (2) by induction. Elimination of static in paper can be accomplished only if electrical conductivity is established either in the paper or in the air near the paper. Air is an insulator and must be ionized to become electrically conductive. Paper is an insulator when dry, but can be made conductive by absorbing moisture, such as by storage in a humid room. The need for further study on the problem of static electricity was emphasized. Mr. Walkup concluded that in spite of the advances made in understanding the problem, many unsolved problems remained. A systematic research into the principles underlying static electricity should uncover a number of facts which might have considerable economic value to the pulp and paper and its allied printing industry. From our present knowledge no set rules for elements of static electricity can be given. Each problem must be analyzed and studied as separate problems.

B. M. Morris, *Recording Secretary*

Front row, left to right: A. H. Nadelman, Sec.-Treas., Michigan Div. APPMSA; F. C. Goodwill, St. Regis Paper Co.—Toastmaster; A. E. Harold Fair, Pres., Alliance Paper Mills, Ltd.—Speaker; Richard Peeters, Chairman of Mich. Div. of APPMSA and Chairman of the Meeting; John Dam, Jr., Chairman of Kalamazoo Valley Section of TAPPI. Back row, left to right: Ray Barton, Michigan Paper Co., Past-Pres., APPMSA; Leon H. Mimms, Vice-Chairman, Mich. Div. APPMSA; Harry Weston, Sec.-Treas., APPMSA; Glen Sutton, Pres., APPMSA; K. P. Geohegan, National Pres., TAPPI; Wm. F. Hathaway, KVP Co., National Executive Committeeman, TAPPI; R. H. Hurst, Sec., Kalamazoo Section, TAPPI; H. L. Vanderber g Affiliate Repr., A. E. Staley Mfg. Company

Kalamazoo Valley

About 400 individuals attended the joint meeting of the TAPPI Kalamazoo Valley Section and the Michigan Division of the Superintendents Association. Richard H. Peeters of the St. Regis Paper Co. presided as chairman representing the Superintendents Association. John R. Dam represented the Kalamazoo Valley Section. Fred C. Goodwill of St. Regis Paper Co. acted as toastmaster and introduced the two national presidents, Glen Sutton of the Sutherland Paper Co., Kalamazoo, Mich., and President of the Superintendents Association, and Kenneth P. Geohegan of the Howard Paper Mills, Dayton, Ohio, and President of TAPPI.

The principal speaker was A. E. H. Fair, President of the Alliance Paper Mills, Merritton, Ontario, who talked on "The New Challenge." This unusually fine address dealing with the new training problems of the pulp and paper industry is published as a feature presentation elsewhere in this issue of *Tappi*.

Empire State

Plans for the joint meeting of the Empire State Section and the Niagara Branch of the C.P.P.A. Technical Section are proceeding very well. The meeting will be held at the General Brock Hotel, Niagara Falls, Ontario, on June 19–21, 1953. Following are the officers and committeemen that are handling the joint meeting details: Chairman, J. S. Reichert; Co-Chairman, S. G. Stapley and I. V. Earle; Secretary, W. A. Logan; Co-Secretary, F. P. Heil; Treasurer, G. K. Storin; Technical Program Chairman, R. C. Shearer, and Co-Chairman, W. H. Morrison; Hotel Arrangements, A. B. Gorham; Publicity Committee, J. J. Forsythe, Chairman, and W. E. Dykem, Co-Chairman; Mill Visits Committee, H. E. Karberg, Chairman, and J. W. Youngchild, Co-Chairman; Exhibits Committee, D. Hart, Chairman; Prizes Committee, B. J. Staneslow, Chairman.

Four panel sessions are being planned.

On Thursday morning, June 19, the panel will feature "Waste Paper—Its Growing Importance to the Paper Industry."

On Thursday afternoon the panel will feature "Mechanical Pulp—Its Expanding Applications in Paper Manufacture."

On Friday morning, June 20, the third panel will deal with "Recent Trends in Pulp Bleaching Processes." The fourth panel, dealing with "Quality Requirements by Paper Consumers," will be presented on Saturday morning, June 21.

J. J. Forsythe, *Chairman*
Publicity Committee

Empire State (Metropolitan District)

The Metropolitan District of the Empire State Section met at Fraunces Tavern in New York City, at 6:15 p.m., Tuesday, Jan. 8, 1952. About 60 members and guests were present with Chairman W. R. Willets of the Titanium Pigment Corp. presiding. As usual, the meeting was opened by each person standing and introducing himself. The chairman then introduced J. H. Doherty of the Union Bag and Paper Corp., who is the new secretary-treasurer, replacing J. F. Butterworth of Socony-Vaccum Oil Co., who has been trans-

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ferred to St. Louis, Mo. The members unanimously voted to send Mr. Butterworth a telegram of thanks and appreciation for his outstanding job as secretary-treasurer.

After introductions were completed, the proposed program for the March meeting, which will be Ladies Night, was discussed. There will be no February meeting because of the National TAPPI convention.

The chairman then introduced the speaker, L. P. Nicolson, Deputy Director of the Pulp, Paper, and Paperboard Division of the National Production Authority, who gave a very interesting talk on the functions of his division. This was followed by a very interesting discussion not only dealing with the substance of Mr. Nicolson's talk, but with many other phases of the national defense effort. By general agreement, this discussion was "off the record."

Mr. Nicolson's remarks follow:

"You probably have a pretty good idea of the organization of DPA and NPA in Washington. Charles E. Wilson heads up everything as Director of Defense Mobilization; and under him, Manly Fleischmann is Administrator of DPA and NPA. We come under NPA. Our division is in the bureau known as Chemical, Rubber, and Forest Products Bureau. Included with the Pulp, Paper, and Paperboard Division in this Bureau are Chemicals, Lumber, Rubber, Printing and Publishing, and Containers.

"In our division we have four branches: Raw Materials, Paper Manufacturing, Paperboard Manufacturing, and New Facilities.

"The Raw Materials Branch at present is chiefly concerned with the supply of chlorine, sulphur, and market chemical wood pulp. The chlorine situation is very bad at the present moment in the pulp and paper industries and probably will not be much better for the next two quarters. By the end of the second, but possibly well into the third, we may expect an improvement due to new expansion. However, it is interesting to note that one of the large chlorine manufacturers that had canceled all shipments to Wisconsin and Michigan for 1952, has just recently announced that it will ship through the month of January. This was brought about by a drop in their business of manufacturing chlorinated plastics, allowing an additional amount which could be shipped to the pulp and paper mills.

"Historically, it is interesting to note that the greatest use of chlorine started in the pulp and paper industry. Until the problem of liquefying chlorine was solved, most of the production was in own-use plants by the electrolytic process. After the problem of liquefying chlorine was solved and suitable transportation methods developed, plants for the production of chlorine for sale generally began to spring up. Later on the chemical industry began to find many uses for chlorine in the manufacture of different products, and today the pulp and paper industry has lost its position as the chief user of chlorine. At one time the pulp and paper mills held a position of advantage in purchasing chlorine, but today that no longer exists.

"There is one further problem which confronts the manufacturers of chlorine by the electrolytic process today, the disposition of the caustic soda which is, as you all know, produced about pound for pound with chlorine. Any pulp or paper mill that will purchase equal quantities of caustic soda along with their chlorine, will have no appreciable difficulty in obtaining their supplies, but those that want only chlorine will be up against it for some time.

"The short situation was further complicated by the withdrawal of a large percentage of the chlorine that was being shipped into this country from Canada. This had to be replaced by domestic manufacture and the chlorine manufacturers, in reducing their customers, naturally selected the ones to be served in the closest geographical area. This hit the mills in Wisconsin and Michigan especially hard, and it has been very difficult to persuade the manufacturers of chlorine to ship into that area.

"The problem of tank cars is also acute, and the practice of many pulp and paper mills in using the tank cars as their storage tanks does not help this situation. We feel that, if practical, the mills would be wise in securing storage tanks into which the tank cars could be discharged on arrival and returned quickly to the chlorine manufacturers.

"At present there is no Government order controlling the use of chlorine.

"With regard to sulphur, the controlling order, M-69 Amended, has just been released, under which the mills will be allowed to consume 90% of their 1950 adjusted consumption. We feel that our pulp, paper, and paperboard industry will be able to operate satisfactorily under this order, because the mills have done a very good job in improving their efficiency in the use of sulphur and reducing the consumption per ton of pulp produced. However, it will be some time before the effects of the order can be fully determined.

"Probably the biggest problem that we have had under raw materials is the one of market chemical wood pulp, and to explain this we would have to go back and review the chronological record of the pulp controls.

"M-72 was written with a view to effecting a balance of market pulp supply and demand on the theory that we might lose two thirds of our imports of market chemical pulp from Sweden as a direct result of import price controls, or on an annual basis, about 256,000 tons of Swedish market chemical pulp. M-72 had two purposes:

"1. To increase the supply of market chemical pulp by requiring domestic pulp mills to maintain their sales and to reserve 3% of their own use production.
"2. To curtail demand by limiting consumption to 95% of 1950 and inventories to a 45-day supply.

"Direction 1 to M-72, issued on Aug. 10, 1951, subsequently amended the order to permit heavier inventory accumulations of overseas' pulp in anticipation of the closed shipping season.

"*Effect on Controls.* Sweden's reactions to domestic pulp controls were prompt:

"1. In an effort to beat the effective date of United States price controls, she maximized her second quarter shipments to the American market. Sweden's second quarter shipments of market chemical pulp to the United States totaled 92,000 tons, exceeding her average quarterly shipments during 1950 by 8%.
"2. She announced that her third quarter deliveries to the United States would be 50% of normal, and subsequently announced the same cut in fourth quarter deliveries.

"Finland's deliveries of market chemical pulp in the second quarter were 38% higher than average quarterly deliveries in 1950, an increase probably attributable to uncertainties as to the prospective impact of United States controls on future markets.

"The distortions in second quarter deliveries of Scandinavian pulp to the American market make it difficult to assess the true impact of the controls that became effective at the beginning of the third quarter. Certainly, data for the third quarter alone cannot be used in formulating conclusions as to the longer range supply outlook. Nevertheless, these third quarter data do have some significance. These third quarter data indicate:

"1. That Sweden's shipments of market chemical pulp to the United States in the third quarter of 1951 totaled only 26,000 tons, less than one third of average quarterly shipments in 1950.
"2. That Scandinavia's total shipments of market chemical pulp to the United States in the third quarter of 1951 totaled 65,000 tons, less than one half of Scandinavia's average quarterly shipments to this market in 1950.
"3. That Canada's shipments of market chemical pulp to the United States in the third quarter of 1951 totaled 257,000 tons, exactly the same as Canada's average quarterly shipments to this market in 1950.
"4. That United States shipments of market sulphite and sulphate to the domestic market totaled 402,000 tons in the third quarter, exceeding average quarterly shipments for

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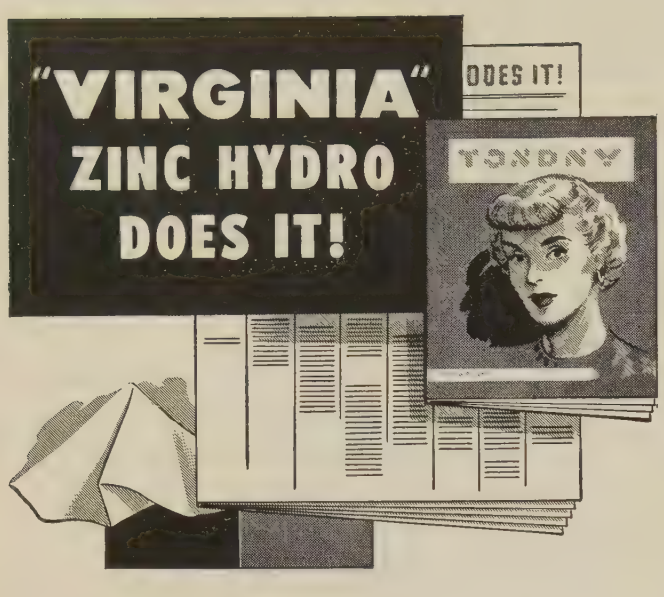

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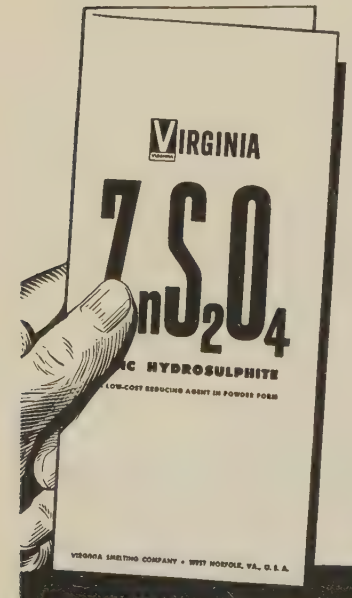

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1950 by 57,000 tons or 16½%—the 'reserve' production requirement was, of course, a factor in this increase.

"5. That shipments of market chemical pulp to this market by all major supply sources combined, including the United States, totaled 724,000 tons in the third quarter of 1951, or 98% of average quarterly shipments to the United States in 1950.

"Thus, third quarter deliveries from our respective supply sources corresponded very closely with NPA estimates of prospective supply levels for the period immediately following July 1, 1951, the effective date of the two pulp and paper orders, M-36 and M-72.

"The supply of paper grades of market chemical pulp available for United States consumption in 1951 was at least 2% less than in 1950 and the supply for other markets at least 13% more. Each major producing country delivered to the United States in 1951 a lesser proportion of its market chemical pulp shipments than in 1950.

"The diversion of pulp supply to other world markets should *at some point* result in a saturation of other world markets and in a consequent increase in the attractiveness of the United States as a market pulp outlet. Any indication of weakening paper markets or exchange problems could speed a balance of market chemical pulp supply and requirements in foreign markets.

"*Present Status of M-72.* NPA plans to effect changes in pulp controls on any single grade of pulp as changing market conditions in any field appear to justify amendment of M-72. For example, if and when the recent decline in rayon production results in a decline in the demand for dissolving pulp, consideration could be given to adjustments in the inventory restrictions and export quotas for this grade of pulp.

"Any convictions that industry groups may have, either now or later, in regard to steps that should be taken to maintain a proper balance in the supply and demand of any grade of wood pulp should, in my opinion, be freely voiced to NPA. Our actions can be more constructive and timely if we are kept fully informed of industries' views on trends and developments. Changes in market conditions are apparent to pulp producers and consumers before they become evident in published statistics. NPA should be kept fully advised of the extent and opinions as to the significance of any market trends.

"Under the Paper Manufacturing Branch, the problem of supplying the Government agencies with their requirements has been handled by NPA Order M-36. At present there are no serious problems reported. As you know, under this order certain percentages of the different grades of paper are set aside each month for the Government requirements. In the fourth quarter, the reserve was an average of 8% and the actual take by the Government was about 6%.

"The New Facilities Branch handles the applications for certificates of necessity and applications for controlled materials for construction, maintenance, and expansion. The applications for certificates of necessity for expansion in pulp, paper, and paperboard are filed with DPA and referred to our Division by them to obtain our recommendations.

"In the last part of 1950 and the early part of 1951, an industry task group, working with the Paper Division at NPA, projected the requirements for paper and board and the necessary pulp, through the year 1955. Under this projection, ceilings for expansion in each grade were set up, and certificates within these ceilings and meeting the other criteria found necessary, were recommended to DPA for certification. A great many of these were certified by DPA before the time in the fall when a moratorium was declared. Since that time no certificates, which have been directed to this Division, have been accepted by DPA.

"We have now been requested to set up a program of expansion for approval by DPA. After this program has been established and accepted by DPA, they will then consider adding pulp, paper, and paperboard to the present priority list. These steps will be necessary before any further certificates of necessity will be granted.

"This program has been developed by our Division, working with Industry Advisory Committees from all sections of the industry. It is interesting to note that the requirement ceilings, as developed on this new program, are not as high as those developed earlier in the year. That is, they are not as high for the year 1954 as for 1954 in the previous program.

"We have now submitted our projected program for consideration by DPA. As stated previously, without approval of a specific program no further certificates of necessity can be granted. However, the granting of a certificate of necessity relates to the privilege of accelerated tax amortization, but does not of itself guarantee the right to start construction of an expansion project. Any new construction or expansion must separately be approved by the Industrial Expansion Division.

"Applications for controlled materials needed for the expansion projects are filed on forms CMP 4C and CMP 4B. At the present time it is very difficult to obtain approval of a 4C calling for steel in the form of structural shapes, copper, and aluminum. Projects requiring structural steel for the 2nd quarter of 1952 have very little chance of receiving the steel, unless they had already received steel in the 4th quarter of 1951 and the 1st quarter of 1952, or in the 1st quarter of '52. Efforts are being made to complete the expansion projects which have already started and are well under way.

"Anyone filing a 4C for structural steel should make sure that he has answered correctly the section covering the percentage of completion of the project. It is also a very good idea to send our Division an information copy of your 4C and a copy of the transmittal letter, with any pertinent information which supports your request for priority. While we are not looking for work, we want you to know that we are in Washington, ready to give you all the information at our disposal and to aid you in any way that we can in maintaining production and expediting the needed expansion projects.

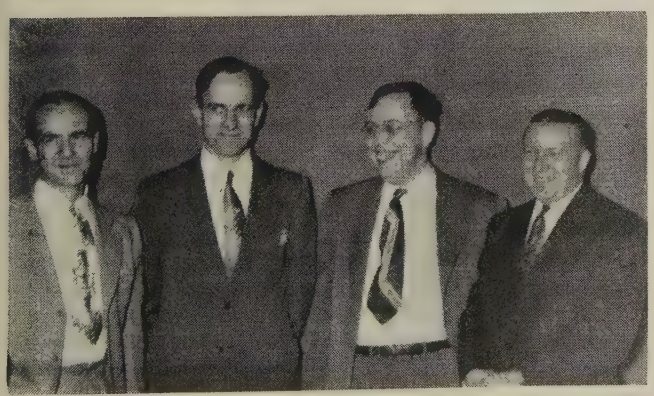
"In closing, it should be again brought to your attention that the service you may expect to get from this Division of NPA will depend to a large extent on the type of men that your industry sends to Washington to work for NPA. So far, we have been well staffed with experienced men loaned by industry, but they can usually only stay for six months to a year and must be replaced constantly. See that the replacements continue to be the best that you can spare.

L. E. GEORGEVITS, *Recorder*

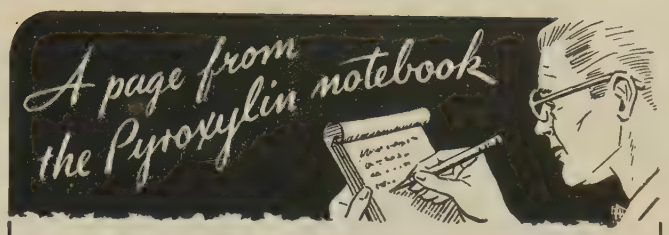
Empire State (Western District)

The Western District of the Empire State Section held its regular meeting on December at the Prospect House, Niagara Falls, N. Y.

Howard Bolton, Assistant Superintendent of Inspection, Harrison Radiator Division of General Motors Corp., spoke on "A Practical Approach to Quality Control."



I. V. Earle, Upson Co.; Howard Bolton, General Motors Corp.; D. Hart; and G. K. Storin, Niagara Alkali Co.



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1. Surface Decoration
2. Surface Protection
3. Addition of Functional Properties to paper surfaces.

1. The DECORATION of paper surfaces may include (a) imparting glossiness, (b) establishment of complete lack of gloss, or (c) equalization of lustre. Sometimes lacquers are used to (d) add color either transparent or opaque.

2. PROTECTION of paper surfaces may require (a) abrasion resistance at either normal or (b) high packaging temperatures. Sparness (c) to water and alcohol are obtained as well as (d) "weather-ability". Paper lacquers are also used to impart (e) water shedding and washability.

3. Among the more outstanding FUNCTIONAL PROPERTIES are the creation of impedance barriers to (a) water vapor, (b) odor and flavor and (c) fats and oils.

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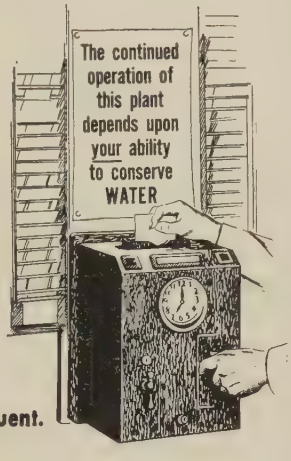

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2. Working standards—how they are established. Some are set up by the Government, some by customers, some by Engineering Departments.

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Statistical quality control is one of the tools used in governing quality production. By use of charts, test results may be analyzed to control production.

S. M. Scaletta, *Chairman*
Publicity Committee

Empire State (Eastern District)

The Eastern District of the Empire State Section met at Milfrank's Restaurant, South Glens Falls, N. Y., on December 13. The meeting featured a panel discussion of "Paper for Its Intended Use."

Lyman A. Beeman, Jr., of Finch, Pruyn & Co., Glens Falls, N. Y., discussed "Groundwood Printing Paper Manufacture." His remarks follow:

"The title of my talk is not simply 'Printing Papers' but 'Finch, Pruyn Groundwood Printing Paper Manufacture.' Our business is groundwood or mechanical pulp preparation and use and our thinking is concerned with the advantages and disadvantages of groundwood printing papers, what we can do to improve the product and the direction to head for in new developments of the sheet.

"Once thought of in the printing business as glorified newsprint good only for cheap pulps, groundwood specialty printing papers in the past 20 years have taken a dominant position in the printing paper industry and constantly grow into new fields and uses once thought the sole property of the free sheet mills.

"To illustrate its importance, here are some approximate figures of the amount of groundwood used in the printing industry. Over 30% of the papers used in printing magazines, periodicals, catalogs, directories (which are part of a group loosely described as book papers) have from 60–80% groundwood content. An additional 20% of this book

T. F. LaHaise, Imperial Paper & Color Corp.; N. L. Rauscher, Diamond Match Co.; E. H. Johnson, Stevens & Thompson Paper Co.; H. H. Lavery, International Paper Co.; L. A. Beeman, Jr., Finch, Pruyn & Co. Inc.; and R. E. March, Marinette Paper Co.

paper group includes coated magazine papers which have 40–60% groundwood content. Beyond this estimate there is substantial paper tonnage in old paper stock sheets and specialized printing papers which contain from 10–30% groundwood. Groundwood in much of this last category is not necessarily used because of availability or cheapness or because it is incidental in the old paper stock, but, because it is an essential to the function of the paper. It is a necessary factor to achieve printability and performance.

"Some of the characteristics of groundwood which have made it so useful for printing are opacity, absorbency, resilience, and compressibility. These qualities are important in a number of different ways. In letterpress printing the resilience and compressibility give a better pickup of ink by receiving the entire type face under the plate pressure. There is also an effect of sheet smoothness, since the pressure evens out the hills and valleys in the sheet. An important advance in the letterpress process was the introduction of high-speed presses utilizing fast drying heat-set inks. This combination demands ink receptive and absorbent qualities which groundwood papers supply. An interesting example of this occurred in the development of papers for *Reader's Digest*. Their program includes using the high groundwood content paper of several manufacturers, among whom are International Paper Co., Finch, Pruyn and Co., and also one manufacturer of a free sheet. In order to get printing results and maintain speed, the free sheet manufacturer found it necessary to change his furnish and utilize some groundwood. The groundwood not only speeded the drying and helped increase the press speeds but gave better reproductions by quick clean ink pickup. There is a definite printing improvement with the cleaning action of groundwood printing papers which achieves successive clear, sharp impressions. In this respect it is interesting to note that through experimentation it was found that balsam groundwood does a better cleaning job than spruce, apparently because of greater resilience in the balsam.

"For rotogravure, groundwood papers also have important printing characteristics. This process requires the paper to pull the ink from the etched ink wells in the printing cylinder. The groundwood compressibility and absorbent characteristics are recognized as being important factors in obtaining good reproductions by the ability to suck the ink from the wells. In roto printing particularly, a smooth sheet is essential. A machine finished groundwood paper can now be used in this process, where formerly only a supercalendered sheet was considered good enough. We still have much to do, however, in smoothing the sheet to make a completely acceptable roto paper.

"From the printer's point of view the natural opacity of groundwood paper is very important in regard to cost and quality. In my experience it was possible for a 45-pound groundwood offset sheet to replace a 60-pound free sheet with the same opacity value. This saving in weight made the change to our paper very profitable. As is true for other values, a small percentage of groundwood in the furnish may give desired opacity with no appreciable change in most other paper characteristics, which has led to the greatly increased use of groundwood for special purposes in many different fields.

"Groundwood does the printing job, it is the backbone of our sheet formation, therefore it is a primary manufacturing aim to get as much groundwood into the paper as possible. The majority of Finch, Pruyn printing papers contain from 70–80% groundwood, depending on use and required strength. To keep this groundwood content, we use a furnish percentage of bleached kraft which must be very well treated in order to give good formation and paper strength. This work is done with Morden refiners which reduce the pulp from a freeness of 700 to a freeness of 275 Canadian Standard. Our grinders also attempt to produce a pulp which combines maximum fiber length and strength with enough fines and avoidance of

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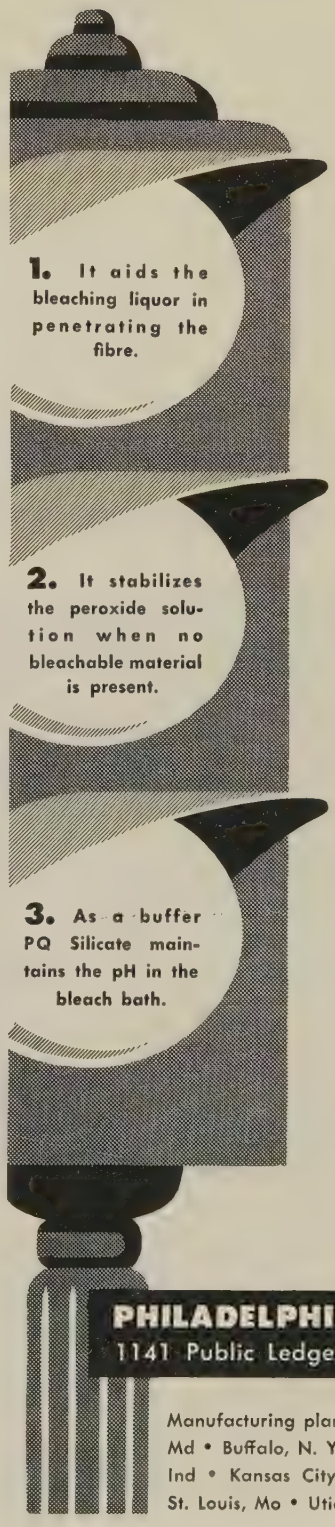
1. It aids the bleaching liquor in penetrating the fibre.
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coarseness to provide a good formation. Here we aim for a freeness test of 60–80, which is slightly higher than most groundwood book mills. Some bursting strength is lost with this high freeness but we believe that the tear and tensile tests are a better indicator in this case and attempt to get higher tear with the long fibers.

"One great stride toward making groundwood acceptable in many printing fields is the development of groundwood bleaching. At Finch, Pruyn our bleach plant now brings pulp brightness from 61–64 to 69–70. The finished paper brightness of 70–71 makes the sheet unstable for high-grade magazine stock and some types of hard cover books. The bleaching is done with peroxide addition to 12% consistency pulp with a retention time for bleach reaction at $1^1/_2$ hours.

"An important ingredient in our book papers is clay. Depending on the weight and finish of the paper being made, we add up to 20% ash content. Better brightness, formation, and smoothness are gained in the sheet as clay is added. Clay helps drainage on the wire which contributes to a good formation that makes a high finish possible. Rapid paper strength loss as fiber is replaced by clay is a limiting factor to the amount of clay that can be used.

"With the characteristics of groundwood that aid printability, there are compensating defects that make many manufacturing problems. One of our outstanding troubles is the wire mark which has made it so difficult to get a smooth rotogravure sheet. Mechanical pulp fibers as compared to chemical pulp fibers are harsh and require more smoothing and calendering. Once the sheet is formed the mechanically produced fibers tend to retain the shape given them and are not easily affected by later action such as the felt presses. Chemical fiber, on the other hand, readily loses the wire marks and is susceptible to a felt marking. These differences require different manufacturing techniques. In our attempts to get a smooth groundwood sheet we use as fine a wire as possible and then hit hard with our smoothing presses and calender stacks.

"In the case of offset papers, groundwood absorbency has hindered our manufacturing rather than helped. Too much starch coating absorbed by the sheet causes brittleness which reduces strength in fold and tear. Drying problems also occur. Groundwood offset is a new sheet now being produced commercially by only two manufacturers. We believe there is a good future for this paper in providing a low-cost, high-performance product for the offset printer. The offset manufacturing process involves coating the paper on a size press with a mixture of enzyme converted potato starch with varying amounts of wax emulsion. Our object is to get a hard, firm surface which will stand the pull of the tacky offset inks. In general our wax pick tests are higher than that obtained on a free sheet with comparable sizing, and pick trouble on the offset press blanket has not occurred. Some difficulty with linting and flaking from the paper surface does appear at times, but seems to be either slitter dust or loose scale starch from surface rupture caused by the sheet sticking to driers following the size press.

"Other applications of the size press operation include coating with starch and clay mixtures either the wire side alone or both top and wire sides of the paper. This coating is done in an effort to reduce two-sidedness and improve the appearance of the paper.

"Some attempts have been made to get a better finish on rotogravure papers by water addition at the size press. Drying capacity beyond the press is an important consideration here and an additive to the water to decrease its absorption into the paper is necessary. The water addition has the effect of evening out the sheet, relieving stress set up by uneven drying, and makes it possible to carry a higher water content over the calenders and still maintain well-wound rolls.

"Moisture content in printing papers is vital. We try to keep between 5 and 6% moisture in all of our papers, since experience has shown this to be the most satisfactory moisture range for stability and performance on most printing jobs.

Both in the mill and in the pressroom good moisture content shows up in greater paper strength and finish. Printability is improved and the paper is less sensitive and easier to handle. Since many pressrooms now have air conditioning the printer looks for a sheet that will adopt quickly to the existing humidity with a minimum of dimensional change. An interesting fact is that groundwood papers inherently have more dimensional stability than free sheet. Being extremely hygroscopic, groundwood paper can carry much moisture and will take up and release moisture quickly but at the same time the fiber will not change in size as much as does the inert chemical fiber.

"With the development of new resins and better manufacturing techniques there are endless possibilities for new uses and application of these products to groundwood papers. Better printing surfaces and resistance to wear are some of the advantages to be gained for the printing industry with these new techniques. Mechanical pulp papers should provide an excellent base for them. While we wait for these developments, however, we, at Finch, Pruyn are working for higher brightness, uniform product, and fewer mechanical faults to make a better printing paper and keep ahead of the field with service to our customers."

The second speaker was Hugh H. Lavery, of the International Paper Co., Palmer, N. Y., who discussed "Printing Papers." Mr. Lavery's remarks follow:

"Regarding printability, the groundwood sheet has certain properties that make it desirable for high-production printing even though it may not have the more pleasing appearance, purity of color, or degree of strength of the free sheet. While it is generally true that a groundwood sheet costs less than a free sheet, there are certain properties of a groundwood sheet which give it preference over a free sheet by many printers. These properties which make the groundwood sheet particularly desirable are the combinations of the following:

"1. Less tendency to curl and cockle than a free sheet. It has better dimensional stability under changing humidity conditions than a free sheet.
"2. A groundwood sheet has better resilience than a free sheet of corresponding weight and equivalent surface. It thereby gives better backing on a press.
"3. It has relatively high opacity.
"4. A groundwood sheet is generally softer than a free sheet of equivalent weight and surface, thereby handling well over a fast rotary press and yet is stiff enough for handling in the folder and bindery.

"These properties go back to the groundwood. A groundwood with a high fraction in the coarse range will give high resilience and high bulk but a relatively low smoothness. A groundwood with low fraction in coarse range will give less resilience and bulk but a relatively higher smoothness yet will retain a certain degree of resilience in the final sheet. Therefore, the desired fractionation and freeness must be that most suitable to the range of grades of paper being produced.

"In the manufacture of printing papers certain requirements must be met. Four general requirements are a must:

"1. The sheet must have sufficient strength (tensile, tear, fold) for operation in the conversion to final printed product.
"2. Uniformity must be a goal.
"3. Proper moisture for the end use.
"4. There is no substitute for good workmanship—good papermaking.

"Beyond these four requirements, the type of printing, the equipment used by the printer, and the degree of perfection demanded of the printer by the publisher are the governing factors.

"The letterpress printer offers to us too many variables to consider; too many for the allotted time for this talk. The variables in this printing may be any combination of basis weight, caliper, bulk, surface, porosity, tensile tear, fold, and degree of softness or resilience. These must be balanced to meet a given printer's requirement. The tensile, tear, fold, and degree of resiliency or softness must meet the press and

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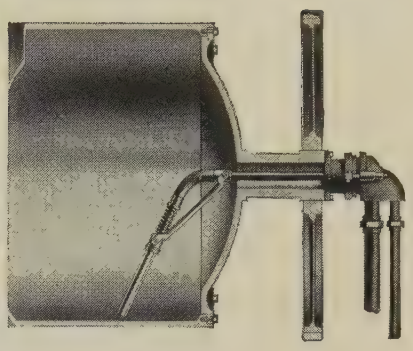

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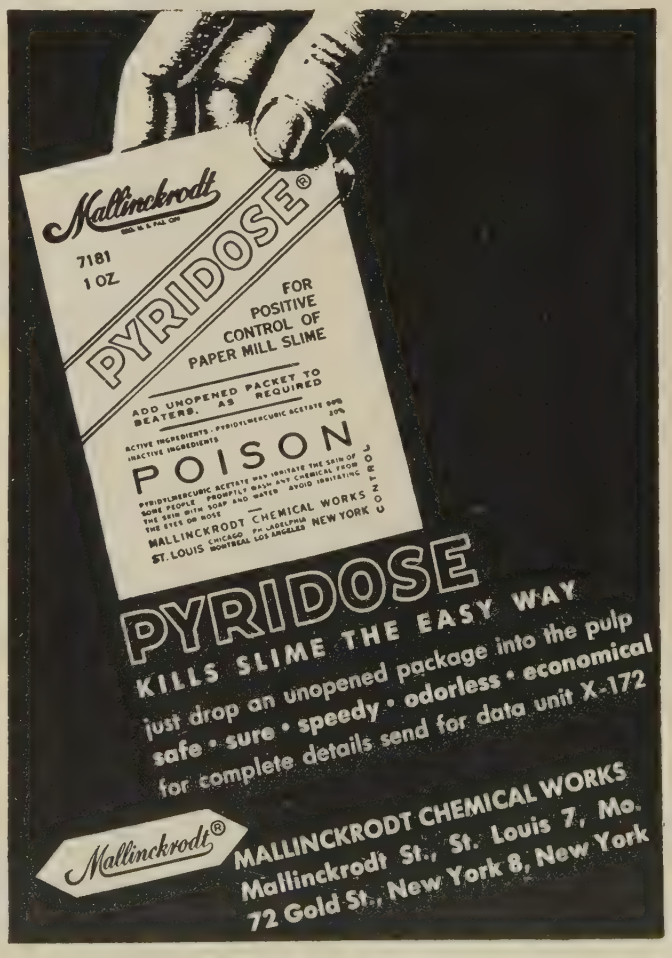
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bindery conditions. The bulk must meet his packaging conditions. The caliper, porosity, and surface—usually expressed as smoothness or glare—must meet the printing conditions. To illustrate the range in this, much paper is printed with oil inks and no heat (drying). Here you need a fairly porous sheet with relatively high caliper and a medium or low surface. On the other hand, much paper is printed with heat-set inks and high heat driers. Here you need a more dense, high-surface sheet with resultant lower caliper. You can cover the entire range of a sheet in letterpress printing.

"On gravure presses, high supercalendered finish is essential for the best work. The gravure sheet should also have considerable resilience or cushion effect. A groundwood sheet given the high finish attains a relatively smooth surface for contact across the gravure cylinder and at the same time gives the cushion necessary to impress the sheet onto the cylinder so even the finest wells register. This sheet is used to a considerable amount in catalog and Sunday supplements of newspapers.

"In lithography, the groundwood sheet also finds its place. It is limited to some extent due to its lower pick resistance as compared to a free sheet when it is desired to use a very high tack ink as in some four-color printing. Other than this one qualification a well-sized groundwood sheet with an English finish has an advantage over the free sheet in that it is less sensitive to cockle, curl, etc., and has better resiliency.

"Publication paper is sometimes coated to give a more dense surface and a more pleasing appearance to the sheet. This paper finds a special place in obtaining excellent production in multicolor letterpress using a 110-mesh or fine screen. This sheet is given a high supercalender finish and is basically a conventional groundwood sheet with its before-mentioned properties but with both surfaces coated. This sheet has a very high porosity test and is printed with inks developed for it. This sheet is beginning to find its place in gravure and special coated sheets are being used in lithography. As everyone here probably knows, supercoated paper is being used extensively in monocolor letterpress for its pleasing appearance. In one application at least a low finish coated sheet is being used in monocolor letterpress.

"We also produce a coated-one side sheet that has the special property of a water-resistant coating. This sheet is printed by any of the three printing processes and is often overvarnished. It finds considerable use for can and bottle label, book covers, liner of boxes, or other uses where water resistance is necessary. One use to which it is peculiarly suited is beer bottle labels. Have you ever wondered how these bottles are dunked in water and a small label on the bottle remains intact? The water-resistant coating hinders the breakdown of the sheet. Another use for this coated paper is in hanging or wallpapers where water resistance is desired.

The third member of the panel was Norman L. Rauscher of the Diamond Match Co., Plattsburg, N. Y., who discussed "Waxed Paper." His remarks follow:

"Waxed paper, as you probably all realize, covers a wide variety and assortment of papers and uses, so in this short talk I will limit my comments to the household variety of waxed papers.

"As this topic 'waxed paper' suggests, there are two main ingredients which go into the make-up of this type of sheet—those ingredients being wax and paper. The end result when these two are combined should be a nonporous sheet which is relatively impervious to the passage of air through it. There is, however, another consideration which must also be taken into account and that is the consumer—and the main consumer is the housewife, yours and mine. The housewife not only wants a sheet which does not permit air to pass through the package she has wrapped with the waxed paper but she seems to also want a transparent sheet—one through which she can see what she has wrapped up. So our company strives to make available to the consumer a sheet of this caliber.

"Let us now examine the steps taken to achieve both of these requisites of a good sheet.

"To obtain transparency, the sheet must be immersed in wax in a manner in which the wax will penetrate the sheet of paper used. The sheet must be saturated with wax to obtain transparency because the more voids you fill with wax the less light reflection you will have—light reflection being the enemy of transparency.

"On the other hand, to produce a nonporous sheet of wax paper, you must add enough surface wax to the sheet to cover up the surface fibers. Even if you have the sheet saturated with wax you will not obtain good vapor proofness unless these fibers are covered. When these fibers are not covered a phenomenon known as 'wicking' will occur—this being where some of the fibers protrude through the wax and act as wicks for the transmission of air through the sheet.

"Let us now look at the way to best obtain a transparent sheet of paper. As I have previously stated in order to get a transparent sheet you must have wax in the sheet to cut down light reflection. You must also have a strong sheet of paper—generally weighing between 16 and 18 pounds depending on the furnish and strength desired by the manufacturer. Most wax sheets are comprised of sulphite or a combination of sulphite and kraft for increased strength. Other furnishes are also used depending on color and brightness desired in the finished sheet.

"So as the sheet comes from the paper machine you look for a method of decreasing the caliper or bulk of the sheet. From the cost point of view it then becomes evident that the less wax you have to put into your sheet the cheaper your operation will be if you want to obtain transparency.

"This can be done by passing through all the nips of one or two calender stacks at the paper machine or by supercalendering the sheet. Both of these processes give the sheet a finished appearance. In supercalendering you can give the sheet a high finish and it is general knowledge that to get best results out of a supercalender you should have a relatively moist sheet and by this I mean 12–15% as compared to 4–6% on other grades such as napkins or toilet. If it is not possible to operate your paper machine to furnish a sheet with this moisture content, it may be added by various means—among these being applicator rolls or spray equipment, placed between the machine and the stack. The values obtained in supercalendering besides decreasing the bulk of your sheet (leading to less wax needed for transparency) and improving surface finish are many—among them being the ironing out of surface irregularities that occur in the sheet coming from the paper mill, the laying down of surface fibers which tend to cause 'wicking' when the sheet is waxed, and helping to impart a high gloss to the waxed sheet.

"After calendering the paper is ready to be waxed. It is believed from the above-mentioned angles of obtaining the best transparency in the sheet, etc., that a double-dip method of wax application is the best type to use. In the first bath or dip the purpose is to obtain maximum penetration and saturation of the sheet with wax to fill in all the voids possible which would reflect light and thus hinder the transparency. The sheet as it enters this bath should be warm, accomplished by passage over a small steam roll, or the wax upon entering the sheet might congeal on contact with cold fibers, thus hindering penetration. Generally speaking the wax should be 15–20°F. above the melting point of the wax being used.

The sheet is then passed through a second bath of wax. The main purpose of this dip is to even up the surface wax of the sheet and add enough to retard 'wicking' and insure a sheet relatively impervious to the passage of air. It is generally felt that enough wax must be added to the sheet to effect at least a 10% caliper increase in the sheet based on the unwaxed caliper. Of course the more wax added the less chance of air passage there will be.

"From here the sheet is then cooled—usually by passage over a series of chilled rolls or through a cold water bath.

"Of course this is just one method of producing a household waxed sheet. Single-dip waxing can produce various types of waxed sheets. One of these is a so-called dry wax sheet where a relatively porous sheet has the wax driven into the sheet and fills the space between the fibers, with very little wax being left on the surface. Here you can obtain transparency but good vapor proofness is missing.

"Another is opaque waxing—or the application of wax to a sheet which has been loaded with an opaque filler. Here you have most of the wax on the surface with just enough penetrating into the sheet to hold or bond the film. In this type of sheet you have water vapor proofness but little transparency.

"The wax used is usually of the paraffin type or a mixture of microcrystalline wax and paraffin. Paraffin waxes have the whitness usually wanted in the wax film, the ability to achieve high gloss in the film, nontackiness but they are brittle, have low grease resistance properties and relatively poor aging qualities at elevated temperatures. Microcrystalline waxes are sometimes used to improve grease resistances and pliability of the sheet to prevent cracking or crumpling when used in wrapping. However, this type of wax has poor color characteristics being on the yellow side unless high purification has been effected. Other nonwax chemicals can be added to the paraffin base to impart grease resistance and pliability to the sheet.

"In general, this has been a quick look at the manufacture of household waxed paper and I hope that in this short time I have left a few impressions."

The fourth member of the panel was J. F. LaHaise of the Imperial Paper & Color Corp., Plattsburg, N. Y., who discussed "Characteristics of No. 2 Hanging Paper." Mr. La Haise's remarks follow:

"It is with some hesitancy and misgivings that I present my thoughts on No. 2 Hanging Paper or raw stock for wallpaper as it is more commonly known.

"Once before when I spoke on this subject, I became involved in a private discussion on base stocks for coating papers with a very learned and experienced gentleman in this field and was quite emphatically told that a paper no matter how it was made could be coated so you can see I fear to be too explicit in my presentation of this subject.

"However, we do find that there are certain characteristics of the raw stock that must be controlled in its manufacture to assist the coating plant to operate efficiently.

"A wallpaper producer usually desires a paper that can be coated easily with a minimum of trouble and one that will run through the converting machines without breaks or stop-offs. He also desires a paper that when coated and printed, can be hung easily by the paper hanger with a minimum of complaints.

"In order to coat easily, a paper must be uniformly formed and dried at a density that will enable it to lay smoothly to the application rolls and jackets on the coating machines so that it will not cockle or curl and distort the coating. This applies also to the print machine where the top colors are applied after coating.

"We find that a density or porosity of approximately 20 seconds gives the best results. As the density increases there is a definite tendency to curl and pucker and any small defects caused by nonuniform drying become more pronounced. If the porosity drops much below 20 seconds the paper will lay well but there is a tendency for the coating to mottle because of increased penetration of the coating.

"Any sizable dirt spots are very objectionable from the coating standpoint. Coarse groundwood, shives, and sawdust in the paper cause a mottled and distorted coating. Wood and foreign dirt such as bark, coal, scale, etc., are very difficult to cover with the coating. Oily dirt such as slime, oil, wax, or size spots are extremely objectionable as they cannot usually be detected until the paper is coated and the oily material spreads out as a translucent spot in the coating.

2

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"Controlled grinding and screening, systematic clean-ups, and proper design of stock systems will assist materially in reducing objectionable dirt.

"Color or brightness is a factor and a G.E. brightness of 57 to 60 is sufficient although a higher brightness would assist in improving light tinted or white coated papers.

"As to finish, a moderate finish is sufficient as a high finish does not materially improve the coating and introduces other undesirable characteristics such as loss of bulk and pliability. However, intermittent distortion of the finish by rough driers or felts or seams is objectionable as the coating will be distorted in a similar but more pronounced manner.

"Sizing has but slight effect on coating adaptability. Slack-sized paper of one to two minutes' ink penetration causes some difficulty but paper with tests above 4 minutes is quite acceptable.

"Now to discuss operating characteristics of the paper on the converting machines.

"A uniformly formed and dried paper with a cross-directional tear factor of 80%, a porosity of around 20 seconds and a burst factor of 25% appears to be quite satisfactory for this operation.

"Paper with a tear factor of less than 80% has a tendency to crack or tear at the edges on the festoon drier racks after coating and then tear diagonally when going through the tension bars on the print, reeling, and rooling machines.

"Paper with over 20 seconds porosity and approaching 30 seconds will curl badly on the drier racks and will cause edge cracks when dried. Sometimes it will curl to an extent where one coated loop will stick to another causing 'stick edges' which tear the paper and cause stop-offs. Paper with 20 seconds or under usually lays fairly flat after coating and causes little difficulty in operations.

"Burst factor of 25 to 30% is desirable as long as porosity is controlled to limits discussed.

"High finish is objectionable as the paper has a tendency to weave on the strain or tension bars and climb the guide flanges on the print, reeling, and rolling machines.

"We now come to the hanging characteristics of the paper.

"Here porosity, burst, and sizing appear to be the most important factors.

"A paper hanger desires a paper that can stand normal handling when dry and one that will accept paste readily but will not soak up so rapidly that moisture penetrates the coating before it is hung. Ink tests of at least four minutes are required and higher tests are a good insurance against complaints.

"Porosity and curl again go together as paper made with over 20 seconds has a tendency to curl on pasting and make it difficult for the hanger to fold the paper in preparation for hanging. When curled the edges dry out and make it difficult to secure paper to the walls. Porosity below 20 seconds is desirable as long as mullen factor is maintained between 25 to 30% range.

"Paper with a burst factor of below 25% is likely to cause trouble because of the hanger's fingers puncturing the paper as it is being hung. Hard sizing assists in maintaining bursting strength after pasting as burst strength will not decrease as rapidly due to wetting.

"I would like to sum up some of the characteristics usually required in No. 2 Hanging Paper.

"Basis weight should not be allowed to vary over 3% below specified weight as strength characteristics may decrease and cause operating and hanging complaints. A variance of 3% over the specified weight may cause complaints because of reduced yield.

"Tear factor should be maintained at least at 75 to 80% cross direction and 65 to 70% machine direction, as lower factors may reduce operating efficiency.

"The burst factor is limited to some extent by necessity to maintain proper porosity, but should be maintained at least at 24 to 26% to prevent possible hanging complaints.

"The porosity should be held below 30 seconds, and preferably 20 to 25 seconds. Higher porosities may cause complaints on converting machine operation, coating adaptability, and hanging.

"Sizings should be maintained at a minimum of 4 minutes' ink penetration test, higher ink test, and are good insurance against coating and hanging complaints.

"The paper should contain a minimum of shives, sawdust, wood, and foreign dirt specks. Extreme precaution should be taken that the paper is not contaminated with 'oily' spots such as slime, oil, wax, and rosin size spots to prevent serious coating complaints.

"Brightness should approach 57 and higher if possible to assist coating operation.

"The paper should have a moderate machine finish with all bulk possible and be free from intermittent markings that may cause coating complaints.

"A moisture range of 6.0 to 6.5% and uniformly dried paper is recommended to assist coating and converting machine operation.

The final presentation in "The Finished Properties of Toilet Tissue" was prepared by W. S. Spiller of The Marinette Paper Co., South Glens Falls, N. Y. It was presented for Mr. Spiller by R. E. March of the same company. Mr. Spiller's comments follow:

"The finished characteristics of toilet tissue are determined in the same manner as for any other product—by finding out what the prospective purchaser desires.

"In the case of toilet tissue, the prospective purchaser is the average consumer, the American housewife. Since she is unable to phrase her desires in specific technical terms, it is our job to go to her and by means of comparative consumer surveys, determine the specific factors which go to make up the general characteristics which she demands.

"No product can command consumer acceptance unless it is a good value—that is, the highest possible quality at a fair price.

"Basically, quality in toilet tissue as measured by the consumer may be expressed as a well-balanced combination of utility, comfort, and appearance.

"What are these consumer specifications translated into practical terms?

"Utility is principally affected by tensile strength, basis weight, and absorbency. Tensile strength must be adequate, the over-all level being as high as is practical without undue sacrifice in other quality requirements, particularly softness. Basis weight is established at a level which will provide sufficient body without adversely affecting softness and flexibility or decreasing value through high pulp costs. The rate of absorbency must be sufficiently fast to provide adequate cleansing and disposability.

"Comfort results from a combination of mechanical softness, as measured by the Clark tester, and a subjective evaluation termed surface feel or hand softness. The mechanical softness factor considers only weight bulk, and flexibility, or flop, and is not fully adequate. Hand softness is evaluated from these standpoints—surface smoothness, pliancy, or drape, and compressibility in the hand, or ragginess.

"Appearance of the finished roll, both wrapped and unwrapped, is of vital importance. Packaging must be neat, attractive, and sanitary to provide sales appeal. The roll must be neatly wound and the perforations neither too hard nor too easy to tear.

"Good, uniform sheet formation is very important from an appearance standpoint, even though it has only an indirect relation to comfort or utility.

"Cleanliness, brightness, and color should be at the best possible level consistent with costs, in order to provide an attractive, sanitary appearance.

"In establishing standards for production, all of these properties, and more, must be evaluated with regard to their relative importance and relationship, and a suitable balance achieved in establishing product specifications.

"Once specifications are established, uniformity of production must be maintained through complete quality testing, comprehensive process control, and skillful machine operation. In addition a systematic and continuous improvement in quality is a necessity, to satisfy the continuous upward trend in consumer standards. Only through uniform production of a product of ever-improving quality can the confidence of the consumer be maintained.

"In achieving this uniform high quality production and the essential balance of sheet properties, the proper use of the right raw materials is, of course, fundamental.

"Much of the desired balance of finished properties may be attained through the use of pulps of varying characteristics in the correct proportions. Through experiment, the types of pulp required are determined, sources of supply are established, and then by means of a thorough and complete pulp testing program and continuous follow-ups with suppliers, uniformity of supply is maintained.

"Strong, long-fibered pulps are necessary for strength, short-fibered pulps for formation or softness, and so on, each type having its own specific advantages and disadvantages which must be considered in determining the most suitable blend for any given purpose. Take the case of groundwood, for example. Its relatively short fiber length can aid greatly in improving formation and in producing a limp, flexible sheet. Its high specific volume tends to give a bulkier feel and more body. Its greater adhesion to metal surfaces is of assistance in creping, particularly on dry-crepe machines. The lower cost of groundwood is a factor to be considered in providing a product of good value. On the other hand, the relatively low brightness and high dirt and shive count establish an upper limit on the amount of groundwood that may be used in a

given sheet without having an adverse effect on the over-all quality of the product.

"In general, in establishing the qualities to be incorporated in the finished product, the raw materials to be used, and the methods of using them, the completed article as it appears on the grocer's shelf and in the customer's home, must always be kept in mind, from the core on which the roll is wound right through to the price tag stamped on the wrapper. In order to attract and hold the consumer, it is necessary to build in the required properties in the right proportions; that is, to tailor the product to her needs and desires.

New England

A meeting of the New England Section of TAPPI was held at the Roger Smith Hotel, Holyoke, Mass., on Friday, Nov. 16, 1951.

Over 75 persons visited the Strathmore Paper Co. in the afternoon which was very much enjoyed. They also visited West Springfield where they saw the Infilco Accelator, recently installed there, in operation. This was of distinct interest and made a better appreciation and acceptance of Infilco movie on the Accelator shown at the evening meeting.

There were 110 in attendance at the dinner meeting and J. F. Baigas, Jr., New England Resident Engineer for the National Council for Stream Improvement, gave a very interesting talk on The Advantages and Disadvantages of Paper Machine White Water Utilization.

Paper machine overflow waters fall mainly into four classes. These are as follows: Machine overflow from: (1) processing new pulp into paper products, (2) processing of old papers into board products, (3) processing of pulp combined with fillers into paper products, and (4) processing of partially washed new pulp produced on location to board products.

Stream pollution problems arising from the first type of operation result from the discharge of suspended fiber only. Tissues, glassine, wrapping papers, and some specialties fall in this classification. The content of dissolved organic matter is very low, hence, the discharge has little oxygen demand other than that of the fiber itself. These mills in this list recirculate to a practical degree and are equipped with screen-type savealls. High degrees of recirculation are feasible with some waters of this type since the low dissolved organic matter content allows high effectiveness of slime control germicides. With others, such as insulating papers this is not possible since electrolyte content must be kept low.

While fiber loss is not high, that lost is generally very fine in character. This makes its retention difficult and separation from the machine water overflow requires the use of high efficiency clarification equipment. The major objection in respect to the discharge of these types of machine water occurs in cases of low dilution where the receiving water is rendered turbid. Stream deposits seldom result from this waste because it is so finely dispersed, hence does not settle at reasonable stream velocities, is incapable of compaction even when settled, and is rapidly oxidized in receiving waters.

Savings obtainable from the recovery of this fiber seldom justify the installation of equipment capable of salvaging it together with the cost of its operation and accessory costs such as added slime control measures required which arise in respect to its reuse. Thus clarification of such machine waters can be looked upon as a waste treatment measure.

In most common use for clarifying machine waters of this type to a high degree are flotation savealls. The advantage of such devices for this job over others is that the fiber is collected in a relatively high concentration and is returned to the system with sufficient rapidity that decomposition or sliming does not occur to a disastrous degree. These are capable, if capacity is adequate, installation proper, and control good, of doing a satisfactory job. The major limitation of all such devices is their sensitivity although this can be greatly reduced by careful installation. More recent devices marketed for this purpose are filtration machines employing diatomaceous or pulp filter aids. These have the advantage of providing a barrier through which the waste water must pass and are not subject to upset. Hence, they can deliver continuously a water of a quality which can be reused in part on showers and similar machine appurtenances which cannot operate on water containing appreciable suspended matter at any time. However, installation and operation costs of the filters are decidedly higher than for flotation units.

The second class of machine water is that produced from the manufacture of board products largely from used papers and boards, mainly news, carton, and various heterogeneous mixtures. Water discharged from this operation varies in character due to the types of stock employed, the product manufactured, and the degree of recirculation of white water within the mill. The volume of effluent per ton of product varies between 5000 and 20,000 gallons per ton although a few mills by means of unusual procedures have reduced this to as low as 1000 gallons. Average discharge for a mill employing savealls and recirculating white water to stock preparation and cylinder showers is about 10,000 gallons.

Most stream pollution difficulties arising from this waste result from the discharge of fairly coarse suspended matter which is largely fiber and other organic debris. A large portion of this will settle at low stream velocities, causing the usual problems associated with organic benthal deposits. In addition to the settleable suspended solids, this waste contains some dispersed matter as well as considerable dissolved organic matter arising from sizing and adhesives as well as products of cellulose hydrolysis and other impurities carried in the old paper. Analysis of the effluents from a large number of mills employing a degree of recirculation and simple savealls

indicates that suspended solids discharged per ton of product vary from 35 to 70 pounds and B.O.D. (5-day) 15 to 30 pounds. From 70 to 90% of the suspended matter is settleable without the addition of coagulants. Reasonably low dosages of alum will cause settling of practically all the suspended solids. Removal of substantially all the suspended matter results in a reduction of from 20 to 35% of the B.O.D.

While clarification of these machine waters present no major problem, handling of the sludge obtained is not generally as readily accomplished. With some furnishes and operating conditions it can be returned to system and incorporated in the product completely, in others only partially, and in some must be disposed of completely. The common method of disposal is lagooning in earth-embanked basins. These are filled with sludge which is allowed to compact following which supernatant water is siphoned off. The residue is allowed to dry to a degree where it can be handled, at which time it is collected by means of a bulldozer or drag line and hauled to dumping grounds. Appreciable land must be available for this purpose in undeveloped areas.

The third class of machine waters listed above are those produced by the manufacture of ledger, book, and similar papers containing appreciable quantities of filler materials such as clays, calcium carbonate, or sulphate. In many of these waters the quantity of suspended filler approaches that of fiber and since they are extremely finely divided rapid separation from the water is not readily accomplished.

Summarized data covering numerous mills indicate that the overflow water contains from 50 to 120 pounds of suspended solids per ton of product and 10 to 25 pounds of 5-day B.O.D. Of the suspended solids between 50 and 70% are volatile.

Until recently, flotation-type savealls were used almost exclusively for clarification of this type of water. Alum in conjunction with glue or resin size must be added to obtain high degrees of clarification. In some cases, fiber has also been added to the feed in order to insure a sufficiently high fiber-to-filler ratio to allow adherence of the filler and maintain a balance in the slurry returned to the machine. Sensitivity is the major shortcoming of the flotation systems operating on these waters since variations in flow, suspended solids, injected air, chemical dosage, and fiber-to-filler ratio all affect the degree of clarification obtained. When operating in balance these devices produce effluents between 20 and 50 p.p.m. in suspended and return with dispatch a relatively dense slurry to the machine system.

Recently attention has been given to the application of high rate upflow clarifiers to these waters. There is little reason to believe that these will prove any more satisfactory than the flotation units. In all probability, results, operating characteristics, installation and operating cost of the two will prove similar.

The fourth and last class of machine waters are those containing appreciable quantities of dissolved solids in the form of cooking liquor residues. Strawboard and semichemical boards are examples of this group. In these processes the pulp is often incompletely washed prior to delivery to the machines. Since the presence of liquor solids serves as food for slime bacteria and inhibits the activity of germicides, recirculation of the machine water to a high degree in the stock system is not practical and fresh water must be employed for the showers.

Three methods have been employed for removing the bulk of suspended solids from these wastes. The first necessitates a complete change in the manufacturing process wherein the pulp is washed to a high degree on vacuum filters prior to delivery to the machines. The other two are strictly disposal systems, the older of which being the sedimentation lagoon similar to that employed for news and chip mill waters. More recent is the application of lime precipitation in a clarifier of the thickener type. This system has not met with much success because the underflow discharged from the clarifier is highly hydrous and resists further dewatering even on the addition of impractical dosages of conditioning chemicals.

The first is the most desirable method but is limited to only a few operations because of high cost and physical limitations. The second method has been successfully applied where suitable land was available and proper attention given to operation. The third has been a practical failure.

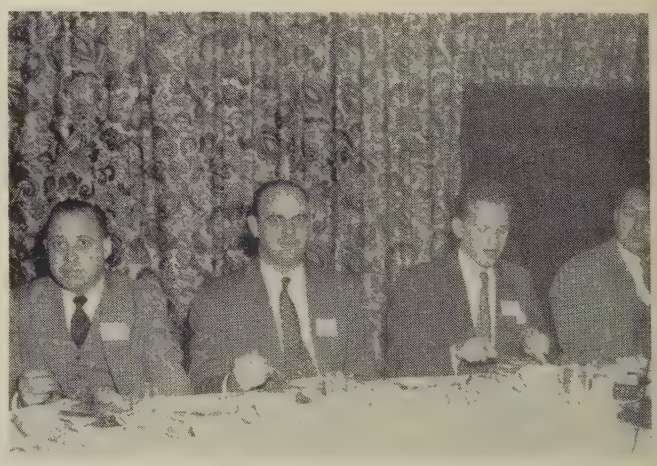
Peter Borlew, Container Corp. of America; W. R. Wade, Brunswick Pulp & Paper Co.; and Reavis Sproull, Herty Foundation Laboratory

Southeastern Pulp and Paper Society

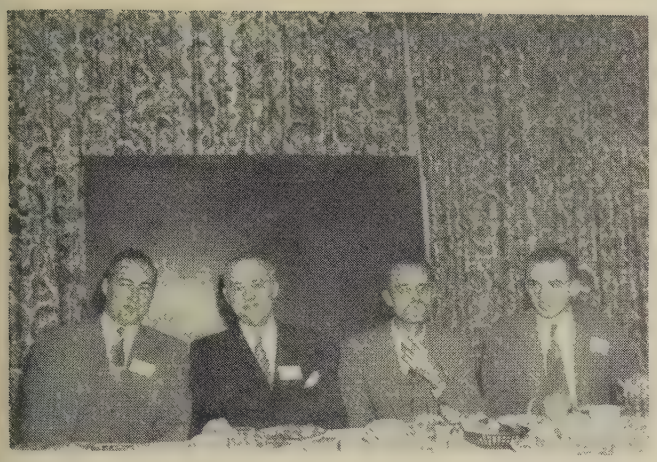
The third meeting of the Southeastern Pulp and Paper Society was held on Nov. 30, 1951, at the George Washington Hotel in Jacksonville, Fla. Attendance at this meeting totaled 78, and included R. S. Hatch, former President of TAPPI, and now Research Director for Hudson Pulp & Paper Co. at Palatka, Fla.; W. T. Webster, Vice-President and General Manager, National Container Corp., Jacksonville, Fla.; G. W. Brumley, Plant Manager, St. Marys Kraft Corp., St. Marys, Ga.; R. E. Phinney, Plant Manager, Container Corp. of America, Fernandina, Fla.; and R. C. Sproull, Technical Director of Herty Laboratory, Savannah, Ga.

Owing to illness, Chairman G. C. Kimble was unable to attend, and in his absence, G. E. Scofield, Secretary-Treasurer, presided.

After introduction of the aforementioned guests, R. E. Phinney invited all present to visit the Container Corp. of America's plant at Fernandina on the following morning. He then took a few minutes to describe operations at his plant, so



M. Prueo, Brunswick Pulp & Paper Co.; Robert Phinney, Container Corp. of America; and George Scofield, Rayonier Inc.



J. R. Lientz, Union Bag & Paper Corp.; W. T. Webster, National Container Corp.; George Brumley, St. Marys Kraft Corp.; and H. T. Robson, Union Bag & Paper Corp.

that those planning to make the visit would have a better picture of the setup.

The secretary then announced that the recent membership drive, including new members signed up at this meeting, totaled 70. A request was made by the secretary that the names of prospective members be sent to him, in order that application forms might be mailed out.

Following the membership announcement, the meeting was turned over to M. B. Pineo, Program Chairman, who introduced the first speaker, H. T. Robson, for presentation of a paper entitled, "Improved Diffuser Operation." This paper, which is a condensation of one to be delivered at the TAPPI meeting next Spring, pointed out ways in which diffusers could be modified so as to substantially shorten the washing cycle without sacrificing cleanliness or chemical recovery.

The next paper, entitled "Problems Related to the Evaluation of the Degree of Delignification" was presented by P. B. Borlew. In this interesting paper, some of the difficulties encountered in making a lignin analysis were discussed. The use of the Roe chlorine number was shown to be a more useful guide in the measurement of high-yield kraft types than the conventional permanganate numbers.

As the concluding feature on the program, a sound-movie, "Paper—The Pacemaker of America," was presented through the courtesy of F. C. Huyck & Sons, manufacturers of paper mill felts. This movie traced the history of paper manufacture from ancient times to the present, and very forcefully presented the importance of paper in both a peace and a wartime economy. At the conclusion of the movie, the meeting was adjourned.

There were 25 visitors to the Container Corp. mill the following morning who were conducted throughout the plant, many of the departments of which are of recent construction.

The next meeting will be held at Savannah on March 21 and will include a mill tour of the Southern Paperboard Co.'s mill at Port Wentworth.

G. E. Scofield, *Secretary*

Problems Related to the Evaluation of the Degree of Cooking

P. B. Borlew

The subject of my talk is some of the problems related to the evaluation of the degree of cooking of wood for pulping. For those of you who are less familiar with the chemistry of wood, I wish to briefly remind you that our raw material consists of about half cellulose, the stuff paper and board is made from, the rest being hemicellulose and lignin. Hemicellulose is almost completely soluble in acid or alkaline liquors used in pulping, and it dissolves very rapidly at the beginning of the cook. Cellulose is supposed to resist the action of the liquors. The removal of the lignin from the wood by gradual solution in the cooking liquor, to a controlled extent, is the goal of all pulping operations. Thus we may substitute for the expression "degree of cooking" the words "degree of delignification." The two TAPPI standards for the quantitative determination of lignin in wood or in pulp do not sufficiently stress their very empirical character and their limited applicability. Hägglund, the Swedish authority on wood chemistry, in the edition of his book which just came off the press, definitely states: "It is certain that lignin cannot be defined as a component of wood which is under all circumstances insoluble in strong mineral acid." This statement limits considerably the value of the classical method of lignin evaluation as originally proposed by Klason in 1908 on which our TAPPI standards are based. Let me quote you a very interesting paragraph from Hägglund's "Wood Chemistry":

"This method is based on the assumption that lignin is completely insoluble in 70% concentrated sulphuric acid and that the cellulose and the other carbohydrates dissolve completely. Under the conditions which he employed, this is practically correct in the case of sprucewood. From this fact, the opinion arose that lignin was in general insoluble in mineral acids since it would not be 'saccharified.' Indeed this supposed property was even used as a definition of lignin. In the course of time, however, it was found that lignin was not under all circumstances insoluble in mineral acids. Under certain conditions it is possible to dissolve appreciable amounts of lignin in acid. Another difficulty in the determination of lignin with strong mineral acids is the fact that the carbohydrates which first go into solution are sometimes converted to humus and thus cause too high a value to be obtained for the lignin content."

The action of strong mineral acids is a more or less violent attack on the carbohydrates and the lignin, resulting in a possibly incomplete hydrolysis, an uncontrolled transformation of the lignin, and a secondary condensation of sugars and lignin elements. The German authority on lignin, Freudenberg, and his co-workers, tried to find the best concentration of acid in order to obtain reliable results and to avoid residual polysaccharides in the lignin on one side and the formation of humus on the other side. It was found that the mentioned sources of errors are more dangerous with respect to hardwoods than to softwoods, as hardwoods present a continuous increase of the apparent lignin yield with an increase of the concentration of the acid. Fortunately, in the case of softwoods, we observe an apparent yield minimum at a definite range of sulphuric acid concentrations. How did Freudenberg know that the minimum yield is equivalent to the true lignin content? The answer to this is a definition of lignin as suggested by Freudenberg: the so-called "acid lignin" is that reaction product which is obtained with the highest methoxyl content at rising concentrations of sulphuric acid and the "lignin yield" is defined as the amount of lignin of a maximum methoxyl content produced with an acid of a corresponding concentration.

Although as a rule the methoxyl content is considered a criterion for the purity of lignin, it should also be pointed out that too high methoxyl values are obtained when lignin remains for a long time in contact with strong acids as this leads to condensation reactions involving the loss of water and consequently, an increase in the methoxyl content. Otherwise, the methoxyl determination is an easily performed check on the lignin purity. The methoxyl range for softwood lignin is between 15 to 16%, the one for hardwood lignin 20 to 22%. Let me briefly illustrate with some tables the meaning of Freudenberg's experiments, e.g., for:

	Sprucewood				
% Concentration of H_2SO_4	62.5	66.5	70.5	75.0	80.5
% Yield of lignin	30.1	26.3	26.2	26.2	29.9
% Methoxyl content of lignin	14.8	15.6	15.9	16.1	13.4

As you see, the yield is constant between 66.5 to 75% concentrated H_2SO_4, with a fairly pure degree indicated by a methoxyl content between 15.6 to 16.1. Quite a different picture resulted from the same type of data for hardwoods, e.g., for:

Oak Wood

% Concentration H_2SO_4	62.5	66.5	70.5	75.0	80.5
% Yield of lignin	20.0	21.5	22.4	25.3	34.1
% Methoxyl content of lignin	17.4	19.6	20.1	20.4	12.8

As you see, no minimum yield of lignin is obtained in this case. The maximum methoxyl content would indicate the use of a 75% H_2SO_4. But again the neighboring methoxyl content of 20.1 which is only by 0.3% lower could be due to the fact that less methoxyl was split off from carbohydrates (they too are able to secure methoxyl as Ritter demonstrated) and that a meticulous determination of those extraneous methoxyl groups was overlooked for some reason or other. Then the picture changes considerably in that a by 3% lesser lignin yield will be secured with a 5% weaker acid. A similarly dissatisfying result is obtained when beechwood is analyzed. And what of hard- and softwood mixtures? This would not be an easy problem to solve. Hägglund and his co-workers investigated some of these problems rather thoroughly and especially with respect to softwood pulps and came up with a refined method comprising several new features, among others, digesting with the acid in vacuum. These refinements of the Klason-TAPPI procedure apparently result in a quantitative saccharification without formation of humus. Jensen confirmed the findings of Hägglund and his school in a paper published in 1949, and found that correct lignin values will be obtained by using the following concentrations of H_2SO_4:

Pine 72% resulting in a yield of 26.1% (methoxyl 15.8%)
Spruce 74% resulting in a yield of 25.3% (methoxyl 17.2%)
Birch 71% resulting in a yield of 17.6% (methoxyl 21.0%)

In the light of these findings, I submit that the TAPPI standards for lignin in wood and in pulp, both, should be rechecked and if necessary revised. Notwithstanding the fact that these standards call for a 72% H_2SO_4, which is correct for pine according to Jensen, the other precautions suggested by Hägglund, if not observed, may lead to erroneous results despite a correct concentration of the acid.

The more or less critical attitude of the leading wood chemists toward the classical lignin evaluation method manifests itself in several recent publications dealing with the so-called "soluble lignin," in particular the "acid-soluble lignin." It was discovered with many a misgiving by Von Wacek in Austria, by Jayne in Germany, by Campbell in England, by Wise in United States that somehow the sum of cellulose, hemicellulose, and lignin in wood, particularly in hardwood, does not add up to 100%. For instance, in a tropical hardwood under examination about 1 part in $6^1/_2$ of lignin seemed to get lost somewhere. Surprisingly, this amount of lignin disappeared equally whether determined directly with mineral acid or indirectly via a sodium chlorite determination of the holocellulose. In a very ingenious but complicated manner, which would take too long to explain, Von Wacek and Schrauth eventually arrived at a formula how to determine the true value of lignin in that tropical hardwood. Its total lignin consists of the sum of (1) a sulphuric acid precipitated lignin fraction of wood which has been previously degummed by a 5% NaOH solution, (2) the soluble lignin fraction in the filtrate of (1) and (3) the lignin fraction recovered from the 5% NaOH degumming solution. For softwoods such as spruce the true lignin content is composed by two fractions only (1) an acid-insoluble lignin and (2) the lignin recovered from the filtrate of the (1) determination. The results of these methods indicate that the true lignin values are higher than hitherto assumed. For instance, the figure for spruce resulted in about 34% lignin. Summarizing Von Wacek and Schrauth postulate that the lignin content of wood is not

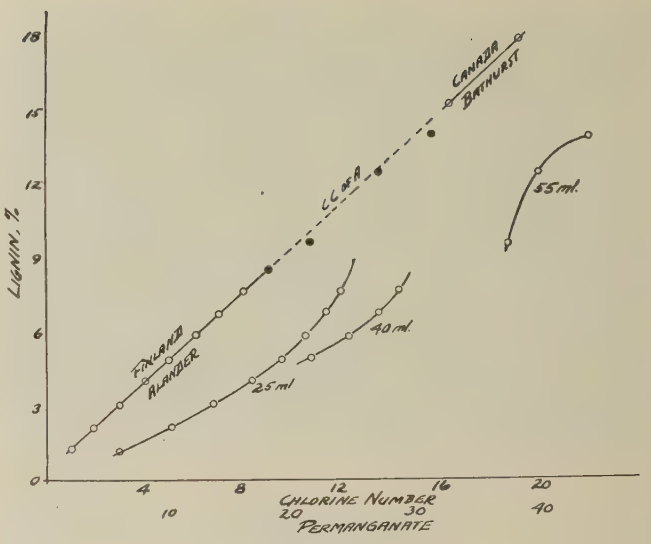


Figure 1

identical with acid lignin and that acid lignin is not identical with native lignin. The preoccupation with a correct evaluation of the lignin content of wood and pulp has a very practical aspect for daily operations in the mill. Our control methods for the degree of cooking need a reference method in order to determine their relative value and accuracy.

This last problem of the relative value and accuracy of certain control methods such as permanganate and chlorine number entered a rather acute stage during the last year. The cause of it was the rapid advance of the so-called "high-yield kraft" process, adopted by quite a number of mills which are either already in full operation or in the planning stage. The process is distinguished from common semi or quarter-kraft cooking serving the corrugated medium industry by its applicability to test liner production. This is, as you may know, achieved by a combination of a shorter cook, less chemicals, and hot stock prerefining resulting in a product which is at least equal to the presently made kraft liner in pertinent physical characteristics. Its main chemical characteristic is a high lignin content. And here is where the problem of the degree of delignification again appears, this time with an urgent call from the operating man.

The Alkaline Pulping Committee of TAPPI realized the seriousness of the problem and appointed a subcommittee in February, 1951. We contacted the three foremost research institutions connected with the pulp and paper industry, one on the West Coast, one in the Middle West, and one in the East. The results of this correspondence were discouraging—none of these academic institutions could recommend a control method superior to what was already known from the corporation which was pioneering in high-yield kraft, namely, Bathurst Power and Paper Co. in Canada. This company had developed the Roe chlorine number test to such an extent that it could be performed within one half of an hour or less by a trained technician. This Roe chlorine number, as simplified by Bathurst, is now under investigation as to its agreement with the lignin content and a confirmatory research project to be executed by a very competent and nationally acknowledged institution is in the preparatory stage.

Let me tell you now why this TAPPI subcommittee arrived at the conclusion that the Bathurst chlorine number is worth while investigating and that its relative value is superior to other control methods suggested or practiced.

Of course, we eliminated from the start all such methods as would take longer than about half an hour to perform. Among others, we discarded the Tingle bromine number which, by the way, would require a none too welcome mineral acid digestion of the sample. The idea to extend the TAPPI permanganate number beyond its present standard of 40 ml. is being tried in some places. Those of you who were present at

the Fall Superintendent's meeting in this room will remember that Port St. Joe is experimenting with a 60-ml. 0.1 *N* permanganate dosage and a total volume of 1810 ml. Dr. Cohen from the Australian Council of Science and Research told me this Summer in Appleton that he had hopes to succeed if the ratio of added permanganate to the probable permanganate number is kept as 5 to 2, e.g., 100 ml. 0.1 *N* permanganate in a total volume of 600 ml. I know of several other laboratories trying to establish a relationship between permanganate and lignin or at least between permanganate and chlorine. In the best case, these efforts will lead to an arbitrary and empirical method, full of exceptions and exclusions. How could it be different? Our present TAPPI permanganate test has a fundamental drawback: the closer we come to the limit of the excess of permanganate, the more uncertain and dubious the results. To quote an example: Alander, the Director of the Cellulose-Analytical Institute of the Finnish Pulp and Paper Industry, just published an investigation stating that for sulphate pulps in the region of 5 to 8% lignin, the permanganate number will be between 19 and 24 on the 25-ml. scale and 21 to 29 on the 40-ml. scale. What will conceivably be the situation if the limit is approached on the 40-ml. scale? Can a permanganate number of say 33 or 35 still be trusted or would such a number show up as 40 or 45 on an extended scale? How far will the scale have to be extended to guarantee a correct reading? What physico-chemical conditions are to be observed in order to be sure of accurate and reproducible results? The Institute of Paper Chemistry holds that in certain cases the permanganate for high lignin content pulps passes a maximum. Another drawback to be expected from an extended permanganate test is the influence of wood species, process type, conditions, etc., which do not seem to affect the Bathurst chlorine number. Johansson, in 1936, summarized the advantages of gaseous chlorine over other reagents in that its action takes place by constant chlorine concentration during the whole reaction time, whereas the action of permanganate is dependent on the concentration of the solution at the beginning and the end of the reaction time.

As a matter of fact, the most startling argument in favor of a chlorine number test appeared to me a few weeks ago when I plotted the Alander and the Bathurst data on the same graph.

On Fig. 1, you see the lignin values ascending vertically and the permanganate or chlorine numbers moving horizontally. In the right field, you see several curves with an outspoken curvature indicating that sooner or later the values will lose their usefulness. The two closer ones are Alander's lignin values for a sulphate pulp plotted against (1) 25 and (2) 40-ml. permanganate concentrations. The third upper right curve is also a lignin versus permanganate curve based on an extended concentration of 55 ml. The lower left straight lines are Alander's lignin values plotted against Roe chlorine numbers. The short straight line on top of the chart connects two lignin values of an unscreened high yield kraft pulp plotted against the corresponding Bathurst chlorine numbers. There is no difficulty in connecting both straight-lined curves with a third straight line under the same angle as shown by the dotted line. It is striking that pulps made and tested in Canada and in Finland, respectively, should indicate such a perfect conformity of lignin and chlorine number of over a range reaching from 0 to 18% lignin. Apparently, we are entitled to such a connecting line for I happened to find in our laboratory records of tests of a few high lignin content carrying pulps. I marked the results on the chart with solid dots and you will concede that they fit very satisfactorily into the picture—in contradistinction to the permanganate curve to the extreme right also resulting from our tests.

Concluding, I wish to say that the reasons for electing the chlorine number as a routine control test in high yield as well as in ordinary kraft cooking are sufficiently strong to warrant its successful and useful application in mill operations.

Empire State (Central District)

The Central District of the Empire State Section met at the University Club, Syracuse, at 7 p.m. on December 7. Ninety-two attended. C. E. Libby presided as chairman.

The group was honored to have many distinguished guests. Professor Libby introduced Wayne Morrow, Chairman of the Northern District; Irving Earle, Chairman of the Western District; R. D. Moynihan, ex-chairman of the Eastern District; and Chase Mather ex-Chairman of the Northern District and a member of the Section Executive Committee.

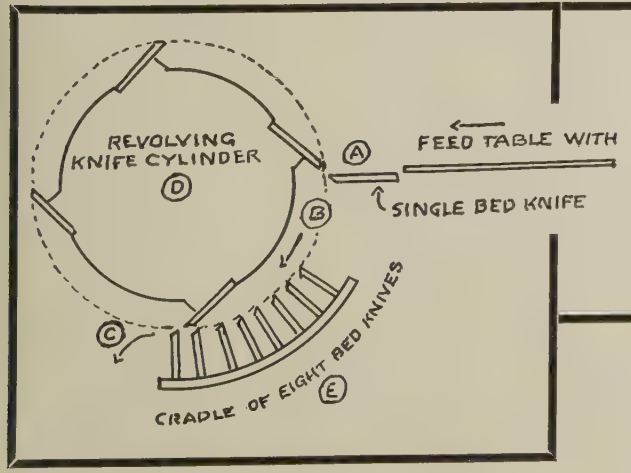
The group was addressed briefly by Henry Perry, Chairman of the Planning Committee of the Empire State Section; Ralph Kumler, Vice-Chairman of the Metropolitan Group and member of the National Executive Committee. J. S. Reichert, Chairman of the Empire State Section, offered congratulations to the Central New York group on its highly successful reactivation. He gave an outline of the 1952 Empire State Section meeting to be held jointly with the Canadian Section in Niagara Falls in June.

It was indeed an honor to have in our midst Kenneth Geohegan, National President of TAPPI, and one of the high lights of the evening was his brief word of welcome.

The main speaker of the evening, J. W. Oren, Research and Development Center of the Armstrong Cork Co., was introtroduced by Fred Sommerville, Plant Chemist for Armstrong Cork in Fulton, N. Y.

Mr. Oren gave a most interesting talk, illustrated by slides, on "Some Operating Characteristics of a Paper Machine Drier Section Equipped with Forced Ventilation." A lively question-and-answer period followed the presentation of the paper.

B. J. Wortley, *Secretary*



RAGS CUT 32,400 CUTS PER MINUTE WITH TAYLOR-STILES MULTIPLEX RAG CUTTER

This modern machine, used by roofing felt manufacturers, has six knives on the revolving knife cylinder. It has nine bed knives. This means 54 cuts with each revolution of the cylinder, 32,400 cuts per minute at 600 RPM.

The rags are cut extremely small as they pass through the bed knives—small and very fast.

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Pump Troubles with Mixed Furnishes

PARKMAN A. COLLINS

FROM casual observation of our wastepaper baskets at home and office it is evident that the paper industry is producing new kinds of paper at a rapid rate. We are also keenly aware of this from the effect on pumping equipment in the mills. Sometimes we learn it the hard way which is not soon forgotten.

We will omit lengthy reference to entrained air problems on pulped stocks occasioned principally by plunging runarounds, beater dumps, furnish transfers, excessive agitation, etc., because we can design to meet it and because we have all learned quite well to treat a stock chest like a glass of beer by keeping the air out of the stock as much as possible, usually accomplished by pouring against the side of the chest or by suitable baffles. If anyone needs further education along this line, let him attend an underwater movie and note the heavy sheath of air which is carried down by a diving girl (most people look at the girl) or take the *Maid of the Mist* at Niagara Falls and note the difference in the volume of air coming up through the water from in front of the American side where the cataract is baffled by the rocks and compare it with the Canadian side where there is a free fall (most people look at the falls). Excessive air in stock can be a problem but it can always be solved by cooperation of the pump man and the mill man by considering layout, arrangement, etc., even with standard pump construction. Excessive entrained air in water or white water can also be handled readily and this refers to any layout, regardless of pressure or vacuum at the inlet or the length or grade of suction pipe. Vented suction chambers connected to vacuum through vacuum air traps are effective and reliable as frequently illustrated on water works installations in driven well fields. The same principle is used in condensate work and also in preventing air binding of double suction water and white water pumps, particularly where there is a suction lift or the submergence zero and the flow variable, such as encountered in some deinking layouts.

The problems on which we do not have the answers (although we are working on them) are those pertaining to certain stock characteristics. We mentioned the variety of papers. In addition to standard furnishes such as groundwood, sulphite, soda, sulphate, and waste in all colors and all stages of refinement you are asking the pumps to handle jute, cotton, wool, asbestos, certain chemicals, plastics, and various other additives. The consistency, type and length of fiber do not bother us particularly and neither does the freeness or slowness, but certain gaseous conditions occasionally play havoc with a pump installation. This problem appears to be related to vapor pressure or surface tension or a combination of both. It is not the familiar problem of excessive entrained air originating outside the pump, but the result is exactly the same, that is, the blocking of the impeller inlet with gas, commonly called air binding. It acts like the so-called steam binding or vapor binding which sometimes occurs in boiler feed or condensate service. But whereas we thoroughly understand flashing of water at pressures under equivalent temperature and can figure the exact submergence, permissible temperature rise, and amount of recirculation to overcome it, we lack the knowledge to handle these same factors precisely in the case of special furnishes, which, in effect, appear to be just as ready to flash and give off vapor. Sometimes foam is in evidence and sometimes not, the same as boiling water or gasoline, but the vapor is there just the same and becomes displaced by the solid liquid within the pump back to the area of the impeller inlet. Perhaps the time will come, when, in addition to consistency and pH values, we will ask you, "What is the vapor pressure of this stock and what is its surface tension?" This may become necessary for the advancement of reliability. It would involve more calculations on our part and complicate things in general which, incidentally, is nothing new in our business or yours. On certain furnishes, however, the figures would call for abnormal suction heads which would be impractical for those frequent cases where you wish to draw down and use the last pound of stock, if possible.

A way out of all this and a better way of handling these gaseous stocks would be to vent impeller inlets to vacuum as we do on condensate hot-well pumps or on white water separating pumps but the obvious stumbling block is getting the gas through the stock and leaving the stock behind without plugging the removal apparatus. This is a real challenge to some mechanical wizard, wherever he may be. We believe it will be done. If it is, it will mean complete reliability of centrifugal pumps, not only on gaseous stocks but also on stocks containing excessive entrained air even though the pump is located far from the chest with an unfavorable suction connection. We would not be afraid of an unfavorable suction connection on foamy stock right now if you were willing to operate a steam ejector of suitable size connected to the impeller inlet. This would remove some stock with the gas but the discharge could be directed back to the chest and perhaps the extra hydration would be worth the cost of operation in some cases.

We challenge someone to devise an apparatus which will remove air from stock in a small, enclosed space and leave the stock behind. It might be a simple arrangement. Someone is almost sure to do it and thereby make a worthy contribution to the reliability of stock pumps under all conditions.

Until then, we must ask for favorable inlet conditions and quite naturally, much more so for some cases than in others. In order to make these recommendations precise, as in boiler feed and condensate work, we challenge someone to work on the vapor pressure and surface tension properties, methods of testing for, etc., which would probably enable us to calculate our limitations with at least as much exactness as we now determine total working discharge head.

Presented at the Sixth Engineering Conference of the Technical Association of the Pulp and Paper Industry, Savannah, Ga., Oct. 15–18, 1951

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GREASEPROOF BOARDS AND PAPERS FOR FOLDING CARTONS

Joint Meeting of the Folding Paper Box Association and the Chicago Section of TAPPI
Chicago, Ill., Nov. 19, 1951

V. V. VALLANDIGHAM: The meeting will now come to order. I would like to welcome you all. We are very pleased to see as many turn out as we see present. Inasmuch as we are running about twenty minutes behind the schedule we have set up for a very ambitious afternoon program, we will pass this right along to Peter Trucano, our program chairman.

P. J. TRUCANO: Well, I certainly won't slow down proceedings because all I am going to do is introduce our moderator for the day. Our moderator today is F. D. Long from the Container Corp. of America.

F. D. LONG: This is rather a new approach for this Section. The Folding Box Association and Chicago Section of TAPPI, in joint effort, are putting on this program today. To my knowledge I have never had the opportunity of sitting in on a session where we talked exclusively on grease-resistant papers and boards for the public need. To my knowledge this is the most widespread, diversified discussion you will have the opportunity of hearing.

Today we are going to take it up from various aspects—coating, films, and so on down the line. It is quite obvious you are interested or you would not have taken the time or money to go all the distances which you have.

I don't know about your experience but mine has been this. We are always looking for the theoretically perfect material which is grease resistant, moisture-vapor resistant, and which is usually water resistant. Perhaps we are a little in error on this whole approach. Maybe we don't have to go about it quite that way. It's conceivable that you wish to make a film which is grease resistant for specific purposes. For example, a doughnut tray probably will have only a short shelf life of a few days. But you may have some sort of cake that may stand for months. Isn't it conceivable that you could have a different film or coating or some type of treatment specifically made for a particular use? I think you all agree that if we try to put in a perfect material with a guarantee against insects, water, grease, and everything else, we end up with a package which is prohibitive in cost for domestic consumption. I think we have tried that in the past and I am not sure it has worked.

The panel of speakers today may not answer all your questions, but I am sure they will make you think. I am sure they will bring out some new aspects. We are going to have four speakers this afternoon and two this evening.

At this time I would like to take the opportunity of introducing our speakers. We have A. I. Totten of Reynolds Metal Co., M. L. Downs of Thilmany Pulp & Paper Co., Kaukauna, Wis.; D. R. Erickson of Kalamazoo who is a consultant; A. T. Luey of Sutherland Paper Co. of Kalamazoo; L. H. Whitmore of the Bakelite Co.; and H. T. Spannuth of Wilson & Co., Inc., Chicago, Ill.

Our first speaker this afternoon is a man a good many of you may know: L. E. Whitmore of the Bakelite Co. It might interest you to know that Mr. Whitmore is making his finale here this afternoon. He is going to be shipped over to London as a representative for them over there. Most Bakelite sales representatives have technical background and Mr. Whitmore is no exception. He attended the University of Washington as a chemical engineer and continued graduate study at the same institution. Then he taught school for a short period of time at Iowa State and since then has been with Carbide & Carbon in their Plastics Department on coatings and adhesives.

The Use of Polyethylene Resins as Paper Coatings

L. E. Whitmore

POLYETHYLENE resins were first made in the United States July, 1942, following several years of experimental work. As most of you know, ethylene resins were placed in large-scale production during the last war under conditions of extreme urgency and for very specialized end use; namely, insulation for radar equipment. This emergency procedure introduced a situation almost the reverse of normal commercial procedure which dictates long periods of exploration of processes and investigation of end uses before launching full-scale production. At the war's end, industry had available relatively large quantities of a new and extremely interesting material but relatively little background on its utilization. That industry moved swiftly despite this latter handicap is evidenced by the present-day shortage of polyethylene. In the wire coating industry, the transition was rapid and smooth as could be seen by the use of polyethylene in power lines and television sets. The adaptation of molders to produce plastic parts was almost as rapid and certainly more spectacular. Because of the nature of the business, the adaptation of polyethylene film and polyethylene coated paper to packaging required considerably longer time but once under way promises to become the giant of the industry.

There are available commercially today six polyethylene resins of varying molecular weights. These are designated DYGT, DYJT, DYLT, DYNF, DYNH, and DYNJ, and have approximately molecular weights of 7000, 10,000, 12,000, 18–19,000, 20–22,000, and 22–24,000, respectively. Of these resins available, the DYNF with an approximate molecular weight of 18–19,000 finds the widest use in 100% polyethylene coatings on paper. The DYGT with a molecular weight of 7000, DYJT with a molecular weight of 10,000, and the DYLT with a molecular weight of 12,000 have been widely used as modificants for paraffin. In both cases, certain manufacturers have found it expedient to depart from these ranges for specific reasons of their own. In addition to those standard materials mentioned, there are available for development or experimental work small amounts of material ranging in molecular weight from approximately 500 to well in excess of 30,000. The properties of these resins vary from oily to greaselike materials in the 500 to 1000 molecular weight range to waxlike materials in the 4000 molecular weight range to soft resinous substances in the 7000 molecular weight range to plasticlike substances in the 10,000 and up molecular weight range. Tables of physical properties are available but summarized briefly, they are as follows:

Viscosities at 130°C. increase rapidly as we proceed up the molecular weight range from 0.4 poise at 1000 molecular weight to 1×10^6 poises at 21,000 molecular weight.

Tensile strength increases from 615 at 700 molecular weight to 3000, p.s.i. at 38,000 molecular weight.

Per cent elongation from 30% at 7000 molecular weight to 625% at 38,000 molecular weight. The brittleness, as measured by modified ASTM method B-746-414, goes from 50% of the 7000 molecular weight samples not breaking at

−16°C. (3°F.) to 50% of the 19,000 molecular weight samples not breaking at −90°C. (−130°F.).

Many other useful properties, such as chemical resistance, moisture vapor transmission resistance, flexibility, and electrical properties do not vary widely over a relatively wide range of molecular weights. The designation of certain ranges of molecular weights as high, medium, and low is highly arbitrary. Present custom is to call molecular weights in the 15,000 and down range low, the 24,000 and up high, and those in between medium.

Polyethylene resins exhibit extraordinary resistance to most corrosive chemicals and solvents at normal temperatures. In accordance with the chemical reactions of saturated hydrocarbons, polyethylene resins can be oxidized by only the most rigorous of conditions. Specifically, polyethylene resin DYNH has been unaffected after five-day exposures at 25 and 60°C. to concentrated ammonium hydroxide, concentrated sodium hydroxide, concentrated sulphuric acid, concentrated hydrochloric acid, pure phosphoric anhydride, and 28% hydrofluoric acid.

Polyethylene has relatively high permeability to oxygen and carbon dioxide gases but low permeability to water vapor. This combination of permeability characteristics allows fresh produce packaged in polyethylene to continue to breathe and live and remain fresh longer without losing weight by loss of water. In comparing gas permeability of polyethylene and vinyl resin films, we have the following data: measured in cubic centimeters per hundred square inches per 24 hours, polyethylene film will allow the passage of 320 cc. of oxygen, 70 cc. of nitrogen, 1500 cc. carbon dioxide, and 0.5 cc. water vapor. Vinyl resin film will allow the passage of 32 cc. of oxygen, 9 cc. of nitrogen, 82 cc. of carbon dioxide, and 2 cc. of water. The water vapor transmission is expressed in grams per 100 square inches per 24 hours at 100% relative humidity. The vinyl resin film contains 20% plasticizer.

In compounding polyethylene, the inherent nonpolar properties of the material impart extreme inertness to solvents at normal temperatures. Consequently, polyethylene resins are incompatible to plasticisers or any other modifiers depending upon mutual solubility for their action. This property is so strongly manifested that it may be said that polyethylene is not overly compatible even with itself. The truth of this apparently incongruous statement is visualized when it is noticed that paraffin wax (essentially a low molecular weight polyethylene) is not mutually soluble in polyethylene when mixtures of the two are cooled to room temperatures. The two crystallize together in an intimate dispersion and the aggregate appears to have properties of each component with no clear-cut compromise in the properties of each component.

Generally, the compatible materials are solids of high molecular weight. Mixtures with polyethylene are possible because the material has low vapor pressure, limited mobility, and can be retained in the polyethylene mixture as a dispersed mechanical phase.

Incompatible materials are liquids, soft resins, or oils with fairly high vapor pressure or high mobility. Incompatible mixtures of these materials and polyethylene are formed because of the failure of the dispersed phase to be retained as a stable member of the two-component system.

Polyethylene resins are being used in increasing quantities to upgrade various paraffin and microcrystalline waxes. Improved clarity, increased block temperatures, stronger heat seals, and other improvements are to be had through such techniques. The addition of polyethylene to paraffin and microcrystalline waxes increases the tensile strength, increases the stiffness to some extent, increases the hardness, and increases the melt viscosity.

The same agents are effective in both paraffin waxes and polyethylene, slightly larger concentrations being required in polyethylene. Since many applications for polyethylene are in the food packaging field, the choice of an antioxidant must be based on both its efficiency as an antioxidant and its lack of toxicity. It is well to bear both points in mind when evaluating commercial antioxidants.

Commercially, polyethylene coated paper is now manufactured in a variety of widths and thicknesses by three basic processes: (1) hot solution, (2) hot melt, and (3) extrusion-lamination. In the interests of brevity, we will include discussions of polyethylene wax combinations with the description of the hot melt method.

With reference to the coating of paper from hot solutions, considerable progress is being made as to the actual techniques used in the process but the fundamental principles are described as follows. Paper can be coated with a thin film of polyethylene by spreading a hot solution of polyethylene onto the paper by means of coating equipment common to the paper and cloth coating industry. Equipment for solution coating consists of a jacketed-type mixer for preparing the hot solution, pouring or pumping apparatus for the transfer of the hot solution, equipment for unwinding the paper, suitable heating lamps or ovens for drying the uncoated paper, a series of rolls or a spreader knife for coating, a solvent evaporation oven, cooling rolls, and wind-up equipment.

Hot solutions of polyethylene are generally prepared from mixtures of toluene, xylene, hi-flash naphtha, or other aromatic hydrocarbons by stirring the resin into the hot solvent with appropriate mixing equipment.

Because of the tendency of such solutions to jell on cooling, it is necessary that the handling process include means of preventing premature cooling of the solution, otherwise, the mixture of solvent and resin will become immobile in the tank, feed lines, or coater. A minimum temperature of 90°C. through the system forestalls difficulties from this phenomenon and insures a free-flowing, smooth-running coating. In the coater itself, hollow applicator rolls are employed which can be heated by steam or hot water. Hot knives are also used, and in this case, it has been found that existing equipment can be modified simply by attaching electrical strip heaters to the blades.

The coated paper should enter the solvent evaporation oven immediately after application of the hot solution. Forced convection ovens with good air circulation and vapor exhaust conventionally used by the paper and cloth coating industry are generally satisfactory. The shorter the distance between the coating head and the oven, the better are the results obtained. Removal of solvents can be accomplished by heating the freshly coated paper at 120°C., but maximum film strength and best gloss are obtained with temperatures in the neighborhood of 150°C. Solvent release is rapid and complete at these temperatures and there is little danger of blistering.

Coating weights from 6 to 22 pounds per 3000 square foot ream have been applied to paper by means of reverse roll coaters or spreader knives.

Polyethylene solutions having high solids percentages introduce the complicating factor of gelation. Although the solubility diagrams indicate that above the critical solution temperature for a given composition polyethylene is soluble in all weight concentrations, nevertheless, the viscosity of polyethylene-rich solutions is very high and such solutions are difficult, if not impossible, to handle on most coating equipment without the use of excessively high temperatures. Thus, the solids contents of polyethylene solutions are usually held below 35%, depending on the solvent and the temperature. A temperature of 90°C. is sufficient to obtain a 35% solution of resin in xylene. As the temperature is lowered precipitation occurs, and a dilatant dispersion of the resin in liquid results, and ultimately gelation occurs. This process is reversible and solution is again completed at the critical temperature.

Lower molecular weight resins than DYNH have slightly lower solution temperatures and accordingly higher solids

contents are obtainable for a given viscosity; but such solutions are not widely used since 100% solids coatings of lower molecular weight resins in the form of hot melts can be applied at temperatures not greatly in excess of those required for their solution.

It is common practice in those few instances where polyethylene is coated from hot solutions to select a higher molecular weight resin than is normally used for coating by either of the other two processes. This naturally becomes one of the advantages of the hot solution system. In addition, the coated paper usually exhibits excellent adhesion and because the coating weight as applied is only partly resin, gage control of the final product is usually excellent. By the same reasoning, very lightweight coatings are perfectly feasible.

For coating with polyethylene wax mixtures, normal procedures, methods, and equipment may be used. Polyethylene will raise the viscosity of the mix, and slightly higher melt temperatures will be required to compensate for the higher viscosity and to prevent separation of the polyethylene during the waxing operation. Application temperatures will vary according to the resin concentration; ordinarily the minimum temperature will be in the neighborhood of 100°C. In preparing polyethylene wax blends, DYGT DYJT, or DYLT can be added directly to a base wax in the desired concentration or can be blended with wax to form a concentrate which is then added to the base wax. Concentrates of polyethylene and wax containing equal parts of each can be prepared and these concentrates appear to offer a convenient and rapid method of dispersing polyethylene in wax.

The coating of polyethylene on paper by the hot melt method differs from the use of wax or polyethylene wax combinations in that special equipment is generally employed as a means of producing a hot melt. Most widely used in this instance is a screw-type plastic extruder which supplies fluid, medium, or low molecular weight polyethylene to the coater. Generally, the coater is a simplified, and in some cases modified, calendered stack. The function of the extruder is to supply a liquid feed to the first roll of the calendered stack which in effect meters this liquid feed to the paper. The adhesion is established in this first stage. Subsequent calender rolls serve to improve the surface and cool the product.

Another, and relatively new method of coating paper with polyethylene involves the lamination of hot, extruded film directly to paper as the film is produced by a screw-type extruder. The extrusion lamination process has excited considerable interest partly because of its desirable features and partly because in many ways it is a new and novel process to the coating industry. Essentially, this method consists of extruding the resin through a slit die head in a considerably thicker gage than is desired. With proper adjustment of web spread, extrusion rate, and temperature, the hot film is stretched to the desired thickness prior to combining with the paper. Penetration is effected between two rollers, one rubber and one steel, with adhesion being partially controlled by roll pressure. As the paper and polyethylene film are carried around the rolls, the water-cooled metal roll solidifies the coating and glosses the coated sheet. This process is easily controlled, permits the use of a wide variety of base stocks and various coating weights, and is capable of high coating speeds. The laminating roll is usually operated at a temperature of 38 to 60°C. (100 to 180°F.). To achieve this temperature range, it is necessary to heat the roll on the start of the run and then circulate cold water through it as heat is transmitted to the roll from the hot plastic film.

Operating temperatures in the high portion of the temperature range are used when maximum adhesion of the polyethylene film to the paper is desired. However, temperatures over 60°C. usually cause the polyethylene to stick to the laminating roll. In many cases, it is absolutely desirable to preheat the paper somewhat before lamination to further enhance adhesion. Pressure does not appear to be as critical as temperature in determining the amount of adhesion between the paper and the plastic. Pressures between the laminating roll and the back-up roll range from 75 to 200 pounds per linear inch of roll length, with 100 pounds per inch being common.

The introduction of polyethylene to the paper coating industry allows for the first time the manufacture of what may be referred to as the ultimate in wax-type coated papers. Considering polyethylene as a very high molecular weight wax, it is logical that polyethylene coated papers should possess the general properties of wax coated papers but to a higher degree because of the increased toughness, extensibility, film strength, etc., of polyethylene as compared with the lower molecular weight saturated hydrocarbon waxes.

This appears to be the case; polyethylene coated paper possesses the properties of waxed paper plus a number of improvements. Polyethylene coated paper is strong, inherently flexible even at very low temperatures such as encountered in deep freeze lockers, it is odorless and tasteless. It has excellent chemical resistance and resists the action of greases both before and after sharp folding. It is readily heat sealable and forms a very tough bond. It has very low water vapor transmission characteristics.

All of the advantages of polyethylene coated paper may also be cited for the use of unsupported polyethylene film. However, the additional strength imparted to the polyethylene film by the incorporation of paper makes the combination usable and advantageous in many instances where neither paper nor unsupported polyethylene film taken by themselves would be satisfactory. There is the added consideration in these days of restricted polyethylene supply of the opportunity of extending the available polyethylene by combining with paper to improve the strength characteristics. Naturally, there are instances where the use of unsupported polyethylene film is advantageous but we feel these instances are rather clearly dictated.

Blending of small percentages of polyethylene with paraffin waxes improves the properties of the waxed coated paper considerably. Polyethylene modified wax coated papers have a higher gloss than straight waxed paper. They are tougher, stronger, harder, and resist creasing even at low temperatures. Blocking temperatures are raised and rub off and chipping during handling are reduced. This latter property can result in considerably longer operation on bread wrapping machines, for example, without necessary shutdown for clean-up.

The properties of polyethylene coated papers and polyethylene modified wax coated papers are not directly competitive but are rather complementary. Polyethylene coated papers may be considered as the high quality, tougher, more durable, more resistant packaging material. The wax coated and polyethylene modified wax coated papers may be considered for less critical applications requiring lower priced packaging materials. The exact field of use of each type is to be determined by the package designer. However, there is a growing market both for straight polyethylene coated paper and for polyethylene-wax modified coated paper.

F. D. Long: Our next speaker is M. L. Downs of the Thilmany Pulp & Paper Co., which company manufactures laminated papers and has recently gone into the polyethylene coating field which Mr. Whitmore mentioned. They also have made asphalt waterproof papers. During the war they were quite active in the duplexing of weatherproof grades. Mr. Downs went to Penn State to study chemical engineering and then continued his graduate work at The Institute of Paper Chemistry where he received his doctorate. Follow-

ing his degree he worked for the Mead Corp. of Chillicothe and since that time has been with Thilmany, and in the last few years has been the technical director of Thilmany. It is with a great deal of pleasure I present Mr. Downs.

Glassine Papers for the Paper Boxboard Industry

M. L. Downs

As we are well aware from listening to our panel members today, there are more ways than one to solve a problem and the problem of the greaseproofing of paper and board is no exception. However, my job today is to show you how glassine and greaseproof papers do the job with the greatest economy.

It may not be fitting at a technical meeting to use an approach based on cost, but that is exactly the approach your managements will use when you attempt to solve for them a greaseproof job. Because of its very nature, paper is eternally a competitor with practically all other materials only because it can be produced very economically in large volumes and in continuous sheets which lend themselves to further converting operations. Glassine and greaseproof score high because they are produced with the economy of a papermaking operation. Greaseproof and glassine grades are now priced in the range of 20 to 25¢ a pound. The next closest self-supporting greaseproof material is cellophane which, on an equivalent basis, is priced 50 to 55¢ a pound, acetate in the range of 85¢, and extruded polyethylene film in the range of $1.00 a pound. We like to think of greaseproof and glassine as being so low in cost as to be figured on a price per square foot, while competitive products like to show their pricing per square inch. It is a fact that glassine and greaseproof, on the basis of square inch coverage per dollar, is two to three times as economical as the nearest competitive film-type material.

Now the next question—what is glassine? We know that all of you as papermakers like to get your hands on actual samples. We have provided some, through the courtesy of the company with which I am associated. We have also included with those samples a booklet issued by the Glassine and Greaseproof Manufacturers Association. That booklet explains in reasonably nontechnical language what glassine-greaseproof is, how it is used, and the properties it imparts to a protective package. You will also notice that the back of the booklet lists the member mills of the Association, all of whom produce papers in the glassine and greaseproof field. This information is probably a little too watered down for some of our technical friends here today, and, to raise the discussion a little above the level of a straight sales talk, we feel obligated to toss in a little technical dividend in the way of an added discussion on the manufacture of glassine.

First of all, greaseproof and glassine are truly paper. They are made from paper pulp but the quality of that pulp is particularly important, and only special pulps are usable. The special pulps are characterized by their high pentosan content and also by the fact that they are usually higher in alpha, beta, and gamma-cellulose than ordinary papermaking pulps. The best quality glassine pulps have an alpha-cellulose content of only 83% as compared with 88% in ordinary paper grade pulps and 95% in rag. It is the constituents which lie between the 83 and 100% which account for the extremely fast beating properties of glassine pulp, which in turn permit the papermaker to convert the pulp into a cellulose jell.

The second point is refining. Glassine pulps receive a great deal more processing than in ordinary papermaking. Hydrating-type equipment, such as stone fillings, broad bars, pressure refining, and stock recycling are all utilized. Quite often the refining total horsepower is not excessive, being in the range of 50 to 100 connected horsepower per ton of daily production, but very frequently hourly production is so low on the higher grades that power inputs up to 300 hp.-hours per ton are not uncommon. This means that stocks are much slower in drainage than for any other paper grades, quite frequently going down into the range of 100 ml. Schopper-Riegler to the wire.

The third difference in the production of glassine-greaseproof grades is the much slower operation on the paper machine itself. Standard fourdriniers are used with the exception that the drainage area is usually considerably greater or the machine speed greatly reduced to allow for drainage and not infrequently high temperatures are used to reduce apparent stock viscosity on the wire.

Now by means of special pulps, extreme refining, and slow fourdrinier operation, the papermaker produces a sheet of cellulose jell with little fiber structure remaining and, with suitable auxiliary softening, tubbing, and machine stack finishing, he produces a semitranslucent sheet known and identified by the name "greaseproof."

Now, if this greaseproof sheet is to be converted into the transparent grade we know as glassine, it goes through the following additional operations. First, the sheet is redampened to a high moisture content range frequently above 17%, may or may not receive additional treatment with softening agents, depending upon the grade, and then very heavily calendered on a special stack alternately filled with soft cotton or paper rolls and heated steel rolls. Such supercalendering stacks contain more rolls than the normal stack and are hydraulically loaded. The loadings run into very high figures and it is not uncommon to find a lineal nip pressure in excess of 1500 pounds. Under the effect of high moisture content, heat, stack slippage, and pressure, the cellulose jell is further compacted or hydrated, any remaining fiber-to-fiber bonds are now converted into a practically continuous cellulose jell, and with the removal of air and nonbonded fiber faces the refractive index becomes uniform throughout the sheet and much higher transparency develops. The sheet coming off the supercalender stack is true glassine. It is still a piece of paper, but one which has lost its fibrous characteristics to a large extent.

The foregoing discussion on the manufacture of glassine rather well explains its resulting physical and chemical nature. Cellulose, being a hydrophyllic colloid, is by nature greaseproof and, with the reduction of the cellulose to a jell and the elimination of capillarity, there is produced in effect a sheet which is strictly nonoil absorbing and highly grease repellent. By its very chemical nature being a carbohydrate, greases and oils are insoluble in the cellulose itself and therefore cannot swell, dissolve in, or reduce the inherent greaseproof nature of the cellulose itself. Grease and oil penetration, when it does occur, occurs by capillarity or across mechanically produced voids in the sheet, and the degree and type of grease penetration can be controlled to a considerable extent by the papermaker depending upon the compromise needed between grease resistance and strength.

We now come to the matter of the testing of glassine and greaseproof papers. Properties such as strength are tested in the usual manner; transparency and opacity are conveniently measured on photoelectric type machines. That leaves us with only one simple test and that is the matter of measuring grease resistance. There is probably no single, simple test in the industry more argued about, more maligned, and on which more variations of tests have been dreamed up than on this matter of the evaluation of grease resistance. I could hardly expect to convince any antagonists of the turpentine test in a matter of a few minutes, and in some cases a few days or a few weeks. Rather, I will merely attempt to explain to you why the turpentine test is used by the glassine and greaseproof industry, why it is an effective test, and why it serves a very useful purpose. The producer of glassine and greaseproof must have a test which will give him readings immediately if it is to be useful for quality control on paper machines and supercalender stacks. The

early producers of glassine and greaseproof papers found that one of the most difficult oil-like materials to contain was turpentine; being of very low viscosity without bieng too volatile, he could, by smearing the material on the sheet, find within a matter of seconds whether or not excessive penetration was taking place. He further found that if the sheet proved to be resistant to the penetration of turpentine it would be resistant to the penetration of oils and greases. He also found that he could dye the turpentine and read the penetration pattern in a matter of seconds. Now, bear in mind the test was designed only for sheets of paper made from cellulose jell. It was not designed to measure the grease resistance of coatings, foils and films for which turpentine might actually prove to be a solvent. In fact, the test was devised in the days when no satisfactory greaseproofing method existed other than the use of glassine and greaseproof papers. The turpentine test is therefore specifically one designed for glassine and greaseproof sheets and we can assure you, as an industry, that a high resistance to turpentine does assure you a high resistance to oils and greases. It is as simple as that. Those in other paper converting fields who have attempted to adapt the turpentine test to other materials have, at times, overlooked the fact of the specific nature of the test. Therefore, we continue to explain and use the turpentine test in our industry without apologies and merely say to other branches of the paper converting field that, if you do not find it satisfactory for your product, find a test that is satisfactory.

And now to get down to the interest many of you have in glassine and greaseproof papers as sheets to be used in conjunction with boxboard.

As you know, greaseproof is available in a number of basis weights, ranging from 20-pound, but more usually 25 up to usually 35-pound, and more rarely 40-pound basis weight, 24 × 36—500. It is almost always in bleached form and can be obtained either without filler or opaqued with titanium dioxide. Opaqued grades are usually used if the boxmaker has a problem with gray or speck-containing liner stock or is producing a tray where general appearance of cleanliness is most important. In supercalendered or glassine form, the sheets are available from dark amber through unbleached shades to full-bleached and in either transparent or opaque. The darker colors are a little less expensive. Opaqued grades are usually used where exposed or where brilliance of printing on an opaque background is desirable.

We have canvassed the members of the Glassine and Greaseproof Manufacturers Association so as to give you the last word as to how and when glassine-greaseproof grades are being used in the folding box industry and we obtained from member mills some of the most specific information, more particularly from Nicolet, Deerfield, Westfield River, Rhinelander, and Thilmany. You will appreciate now that we are talking specifically about the box and carton field and we will limit our discussion from here on to that field. Obviously, glassine is also widely used in many other converting fields, including bags, bakery wraps, foil laminations, ordnance grades, solid fiber drum liners, and so on, but neither the time nor the interest of this particular group would justify attempting to cover the whole field.

Glassine and greaseproof is usually mounted to board using either dextrine types of adhesives or micro or modified micro wax hot melts. Water-base adhesives of the dextrine types are not too satisfactory for several reasons. In the first place, the moisture pickup by the greaseproof or glassine causes the highly hydrated sheet to buckle. Second, because of its greater density and expansion with cnanging moisture content, water base adhesive mounted, greaseproof-lined boards give curling problems, particularly on die cutting. Third, the use of a water-containing adhesive causes the glassine-greaseproof sheet to swell and particularly in the case of glassine may decrease the initial gloss and grease resistance of the sheet. Some of these troubles can be minimized by using modified starches, prepared in the form of high solids adhesives so that the water content is at a minimum. Further, application of the paste to the board side may help but frequently the results are not satisfactory unless closely controlled. The use of greaseproof paper of lower grease resistance works better with water base adhesives and, in certain products such as bakery and doughnut trays, has been used successfully with good economy.

Micro wax or micro wax lamination is generally used and is very satisfactory for the mounting of glassine-greaseproof sheets to board. The hot melt is usually applied to the greaseproof sheet since it will not be absorbed into the sheet and a good continuous moisture-vaporproof film is obtained. In fact, this is one of the primary virtues of using greaseproof type papers since the wax film can be applied and cooled below the bleed point before meeting the highly wax-absorbent board in a combining operation. With the application of the wax to the greaseproof sheet, fairly moisture vapor resistant cartons can be produced with as little as 10 pounds of wax per ream and extremely high moisture vaporproofness in the range of 20 pounds per ream. MVT by the General Foods method as low as 0.6 gram is obtainable with 10 pounds and as low as 0.3 gram with 20 pounds. As has been pointed out by one of the most important of the greaseproof carton fabricators, the use of micro-type laminants also enhances the grease resistance of the greaseproof sheet used. Because of the low solubility of most food shortenings in micro wax, a dual greaseproofing effect is obtained with the greaseproof sheet providing a clean, tack-free, highly grease-repellent surface, and the micro wax layer below blocking any wicking across pin-point failures and, at the same time, providing a high degree of moisture vapor resistance.

As to specific grades of glassine-greaseproof and their uses in certain specific converted board items, opaque greaseproof in either 25 or 30-pound basis weight is commonly mounted to chip-lined board for doughnut cartons, brown-and-serve trays, trays for high shortening content short breads, and similar products. In the case of a doughnut tray with short shelf-life and no MVT requirement, dextrine mounting is often used. For higher shelf-life baked products, and particularly items such as cookies and short breads, wax mounting is used.

In set-up boxes and in certain cases of folding boxes with a bright wood overwrap where the lining is not seen by the customer, the fabricator can frequently use amber grades. In certain cases, such as boxes for powder-dehydrated cheese, an amber grade of glassine is used, wax mounted. You are, of course, all familiar with the fact that in certain products, such as crackers, the liner is folded in the package on automatic equipment without the liner being laminated to the box and frequently a waxed glassine is used. Typical products are pretzels and soda crackers. More recently, there has been a move in the direction of wrapping individual quarter-pound units sometimes using wax laminated glassine as the $^1/_4$-pound overwrap and inserting these in the nongreaseproof-lined carton. Candy cartons are frequently lined, and the selection of the grade of paper depends upon whether or not it is a window carton or whether or not a clean liner is used in the chipboard. Specific products mentioned include chocolate-covered peanuts, licorice cuts, and chocolate bits where a loose fill is used without a separate liner.

Where meat products, such as frankfurters, sliced bacon, ham, are being packaged for supermarket sales, the tray stiffener or blank is most usually faced with opaqued greaseproof and the whole product then subsequently transparent film wrapped. Frequently, because of high moisture content in the product, wet-strength greaseproof is used. Wet-strength glassine or greaseproof is also used in the lining of folding cartons used in the frozen food industry. Wax mounting affords moisture vaporproofness and the hard surface of opaqued glassine in some cases helps to eliminate fiber-pick, particularly if a light overwaxing is used. It is worth noting that by using a glassine or greaseproof sheet a dense pick-free

surface is obtained, which is free from the flaking encountered when coatings are used and which also does not break down along the score lines to the extent experienced with coatings.

Another interesting use of opaque glassine, sometimes in colors, is in conjunction with the single facing of corrugated used in the packaging of bulk candies or in the preparation of dividers or retainers in the packaging of certain transparent wrapped trays of high shortening content baked goods.

We should stress in closing that the virtues of glassine and greaseproof grades for the box fabricator are many. The grades are available in large tonnage in a variety of widths up to those matching any width of board operation and, when it is reduced to the common denominator of protection per square foot per dollar, it is virtually impossible to find any product which will do a better job than will glassine and greaseproof.

F. D. Long: The following speaker worked with moisture set inks and has patents covering that principle. Michigan Research Laboratories was established and it licensed the major printing ink firms in the country; later it was sold to Sun Chemical. Then Mr. Erickson worked with Time Laboratory as a consultant and has since worked on numerous problems which I will just briefly touch on. He has worked with high solid clay slips, sodium peroxide hydroxyethyl cellulose precipitation method for coated printing papers and greaseproof, retention of tear strength of paper after heat set, ink precipitation, casting of hydroxyethyl cellulose in the film. In 1949 he established the laboratory which bears his name in Kalamazoo where he works on coating machines, methods, and materials in chemical processes, printing inks, printing, and packaging problems. I think you will find him a very stimulating speaker and I am sorry we haven't more time to devote to his talk than we have; Mr. Erickson

The Precipitation Method of Coating Packaging Paper

D. R. Erickson

Members of TAPPI and the Folding Paper Box Association, to speed this up a little I will read mostly from the text so that I won't go off in one direction or the other and maybe we can speed this up because I think most of the answers on this process will depend on questions from the floor. This box industry and board industry coating of course presents very many problems. Everybody wants something different and to try and cover all phases is impossible. I think the questions and answers will do a better job of covering these points.

It has long been known that a great many polymers in the form of self-supporting films or continuous coatings on paper or board are completely greaseproof. The problems of greaseproof then seems merely to pick some film-forming polymer and apply it evenly to paper or board. The fallacy in the conclusion, of course, is that the paper or board absorbs the solvent and the polymer and we do not have a continuous film overlying the surface of the paper or the board. With polymers in solution or colloidal suspension it is then practically impossible to coat a continuous film over a porous material such as paper or board without the solvent and the polymer flowing into the capillaries between the fibers and allowing the fibers to extend up through the coating. If the coating is of high viscosity it has a better chance of drying to a solid before a large percentage is imbibed into the sheet, but usually the heat of the driers reduces that viscosity in the process of drying. It is also true that a very heavy coat of such a polymer solution does a much better job than a thinner coat, but the result is still far from perfect. The price is higher, the resultant sheet is much more brittle and subject to breaking on folds. A method of coating that eliminates this absorption into the sheet and gives in one operation a continuous film overlying the base is the hot melt coating that we have heard described a little earlier. This coating must of course be thermoplastic, nonsoluble in oils, and nonbrittle after storage. It is simple to plasticize resins for hot melt applications but difficult to keep these liquid plasticizers from migrating from the coating into the sheet; many plasticizers are also taboo for direct contact with foods because of government regulations. Polyethylene, of course, solves these problems by needing no plasticizers.

A recent method of greaseproofing is based on the method of precipitation. Namely, to use a solution or a dispersion of a grease-resistant, film-forming polymer coated on to paper or board in a normal manner and then immediately before any substantial penetration has taken place into the sheet to precipitate the polymer from its soluble state to an insoluble state. It can no longer penetrate the sheets or allow the fibers to wick through the coating. In this manner a continuous film may be formed overlying the raw stock base. It is extremely low in caliper and basis weight and yet is a complete barrier to oil, grease, or solvents. The polymers to be used in such a process must of course be water insoluble and preferably insoluble in all the solvents except the one in which it is dissolved for application. It must be a film former and have a high tensile strength, stability, excellent flexibility, and contain no deleterious plasticizers. Alkali-soluble hydroxyethyl cellulose is a polymer that seems to meet these specifications. It is soluble only in a dilute aqueous sodium hydroxide solution and can be precipitated from its solution and neutralized by contacting it with any aqueous acid salt or ammonium salt. When this liquid coating has been transformed to a solid continuous film the contained water is no longer held as a solvent but is free water. A large amount of this water can be expressed from the film by running through a set of squeeze rolls. The remainder of the water is evaporated by normal methods of drying. The precipitation method of coating then is very similar to the making of a cellophane film except that instead of forming a continuous self-supporting film of, say, 0.001 inch in caliper, a similar film of much much lower caliper can be made on the surface of the supporting web of paper or board raw stock. The properties of a paper or board so coated are completely similar to the same stock laminated with a very thin sheet of PT cellophane. It is greaseproof, oilproof, and solventproof and is an excellent barrier against oxygen and CO_2 transmission. Its low temperature flexibility for deep freeze packing is no better than cellophane nor are its moisture vapor proofqualities any better than in PT cellophane. Therefore, when moisture vaporproof qualities are needed in addition to greaseproofness these films overlying the paper or board stock must be further coated with a very thin film of lacquer or resin in the same manner as PT cellophane is coated to make it moisture vapor resistant. This operation is relatively simple as low viscosity, low solid lacquers can be applied from a roll and doctored off as a wash coat. The solvent cannot penetrate the HEC film so all of the lacquer or resin remains on the surface as a continuous film overlying the HEC film. Amounts less than $^1/_2$ pound per thousand square feet have proved very satisfactory. It is natural to expect that if we load the HEC film with clay or other pigments that we cut down the grease-resistant qualities. It is surprising, however, that with pigmentations as high as 80% of clay and 20% of HEC that the resulting film or coating is a barrier to oils, waxes, and solvents for over 24 hours. By varying the percentage of pigment, then, it is possible to get any degree of oil or solvent resistance that is desired. When using an overcoat of moisture-resistant resin or lacquer, very highly pigmented HEC coatings can be used, as resistance to the solvent penetration need be only long enough to allow the lacquer to dry before any penetration of it into the sheet. The uses for such coatings are of course numerous. Highly pigmented, it can opaque dark-colored raw stocks and still give a high degree of grease resistance. The highly pigmented coatings have remarkable printing qualities and can be printed letterpress. If the coat-

ing is low in pigment content or unpigmented the printing problem is the same as with cellophane. Gravure printing is excellent but letterpress is more of a problem. Adhesive problems for this type of coated sheet follow the same pattern. For highly pigmented coatings normal adhesives are excellent. For unpigmented coatings the problems are the same as for adherence to cellophane. The problem of pinholes in such a coating is of course the problem of good coating. No pinholes are caused because of sinking into the sheet and allowing fibers to wick through the coating as in the ordinary methods of solvent coatings. Air bubbles in the coating, fish eyes due to improper formulations, dirt, or loose fibers in the coating or on the sheet can of course cause pinholes. The reverse roll type of coater has proved the most satisfactory for this type of coating. The precipitation method of coating offers a new tool to the paperboard mills and converters to compete with their fine-printed boards, laminated boards, interwraps, overwraps, hot melt coatings, and solvent type coatings. It is a method of transforming a liquid coating into a solid film in such a short time there is no substantial penetration of the coating into the raw stock. As a result the film overlies the raw stock and is a continuous barrier. We have some charts here from an article in *Modern Packaging* which someone might want to see on oil and solvent penetration at various coating percentages of HEC against solvent naphtha, turpentine, ethyl acetate, and corn oil. I think it will be much better, instead of quoting all these figures to you, as you wouldn't remember them, to refer to the article. I think it would be a very good idea during our question period which is going to follow, to ask some specific questions so I can try to give some specific answers. Thank you.

F. D. Long: A. I. Totten, Jr., worked for 17 years with Du Pont before he changed his affiliation. Uncle Sam had something to do with it. He worked with the armed services in chemical warfare services and later he had to get rid of a lot of our surplus commodities, something like 274 million dollars worth, which is quite a sum. Since that time he has been with Reynolds as an assistant director of research, and as director of its light metals research and development laboratory; Mr. Totten.

Aluminum Foil-Paper Laminates

A. I. Totten, Jr.

Mr. Long, members of TAPPI and the folding paper box industry, it might seem a little odd to some of you that your program committee has asked a person associated with the aluminum industry to speak before a combined TAPPI and folding paper box industry meeting. You can be assured that I was a little confused in trying to figure how I would talk to a group of suppliers or potential suppliers on one side to a group of customers or potential customers on the other side. I want to alleviate any fears you might have that you are going to be subjected to a long-winded dissertation on the properties of aluminum foil. However, to cover the assignment I will have to touch on these subjects, but I will attempt to do so only to illustrate certain points.

To the paper industry whose production is 29,000,000 tons of paper and paperboard stock annually, the paper used by the aluminum foil industry might seem at first glance to be unimportant. You know we use less than 0.3 of 1% of that 29,000,000 tons. That does seem very small. But here is the interesting point—70% of the aluminum foil produced is laminated to paper, and that paper costs about $15,000,000.

Aluminum foil-paper laminates are the ideal solution to many packaging problems. Let's be specific—0.00025 and 0.00035-gage foils, the types used for most labels and flexible packaging materials, are delicate. They need an economical backing material to permit their functioning on high-speed packaging equipment. In most instances this means papers.

One use of a foil-paper lamination which has received wide acceptance within the past two years is the margarine and butter wrap. This particular stock consists of light-gage aluminum foil laminated to a parchment or greaseproof paper with a nontoxic, grease-resistant, odorless, and tasteless thermoplastic adhesive. The stock is printed and overcoated on the foil side to give an attractive package which is highly scuff-resistant and greaseproof. Tests by the margarine and butter industries have shown that by the use of this foilpaper wrap, the "score" or quality of their products remains almost constant during their normal storage life.

Any of us who like an occasional bottle of beer are acquainted with the aluminum foil-paper labels used on a great many of our favorite brands. However, very few realize that in addition to the eye appeal imparted by this attractive printed label, the label is also water resistant, and consequently, the bottles can be kept in water coolers for extended periods of time without the labels sliding off. The labels in use today for this purpose are the result of years of research. The largest problem has been to develop papers that would disintegrate and inks and water-resistant adhesives that would dissolve during the short period that beer bottles are in the caustic cleaning and label removal vats.

There are a great many dehydrated and powdered foods which cannot be packaged in paper containers because the protection afforded against moisture gain is not adequate. However, by sandwiching a sheet of paper between two light gages of foil, a moisture vapor transmission rate approaching zero is obtained. Many foods packaged in envelopes of this type, such as dehydrated soups, puddings, and dessert mixes, can be kept in their original condition well beyond the maximum market life of the product. These envelopes are also used for the gas packaging of activated dry yeast. In the past only solid metal containers could have been used for this purpose.

Another instance where aluminum foil laminated to paper has found its niche is as an outside wrap for paper canisters for hygroscopic dry food and nonfood items. Here, as in the case with the envelope, not only is the necessary moisture vapor transmission protection obtained, but also sales have been materially increased due to the attractiveness of the printed aluminum. This is an ideal package for dry cleansers and baking powders.

A product which has received wide acceptance in the packaging field consists of foil laminated with wax to a light tissue paper. When heat is applied to the foil side of this stock, the wax melts, bleeds through the tissue, and then solidifies almost instantly when the heat source is removed. The seal obtained is excellent. This basis type of stock is modified to give added strength, when needed, by aqueous laminating a 20 or 30-pound paper to the foil prior to wax laminating the tissue. Materials of these types are being used in large quantities as cigarette carton overwraps for overseas shipment and as both carton overwraps and inner wraps for such items as cookies, dry cereals, confections, and photographic films.

The use of lead foil-paper laminates in war packaging dates back to the beginning of World War II. These materials were developed to provide protection for military equipment and rations whether they were to be used in the foggy cold Aleutians or in the steamy jungles of New Guinea. Aluminum foil was not permitted for these purposes in World War II. Practically the entire aluminum output of this country was allocated to the aircraft industry. These lead foil-paper materials have now been almost completely replaced by either aluminum foil-paper laminates or aluminum foil-plastic film laminates. In most instances a vinyl film is laminated to the foil side of these stocks to provide a heat seal which is unaffected by petroleum lubricants. Since the foil side is placed next to the packaged article the vinyl film and foil provide an excellent grease barrier.

Now let us consider what aluminum foil has done for the

paper folding box industry and what its potential uses are in this field in the future. There are two basic points to consider: first, aluminum foil-paper laminations as carton overwraps; these I have already covered briefly; and second, aluminum foil as an integral part of the carton and as an inner and outer liner.

The development and wide adoption of the foil overwraps have aided indirectly but very materially in promoting the use of cartons. With the food and other industries placing more and more emphasis on gas, liquid, moisture, and light tightness of their packages, these foil materials have preserved business for the paper folding box industry and have opened up new fields for it. One use of a foil overwrap I have not mentioned previously is as a tight wrap for dried fruit cartons. A tight wrap stock usually consists of a printed aluminum foil aqueously laminated to a medium weight bond paper. This wrap is solid glue laminated to the carton and gives the protection against both moisture loss and moisture gain essential to the preservation of packaged dried fruit.

It is safe to say that of the foil being used today by the paper folding box industry itself, over 90% of it is there merely for decorative purposes. For protection purposes it is used for foil-lined cartons for cigarettes, greased or preserved ball bearings, matches to be shipped through the mail, and for chocolates and other confections.

Several of your members are conducting extensive research programs to determine other places where foil can be used to advantage on their products. In this work they are investigating its potentialities as an integral part of the boxes as well as as an inner and outer liner. This is certainly a most opportune time for such research programs. With the present critical shortage of all metals there should be many places where an aluminum foil-paper folding box, both with and without a foil overwrap, could replace solid metal containers. When I make this statement most of you are probably saying to yourselves, "Doesn't this fellow even know that the aluminum supply is short?" Yes, either fortunately, or unfortunately, as the case may be, I do know it, but with other metals just as tight, a proposition to Washington to use a small amount of aluminum to replace a large amount of steel or tin plate should be given excellent consideration. This would be particularly true if the package involved was for perishable food products. I also believe that a great many folding boxes of this type would continue to be used after the present emergency is over because of their merits.

Now let's consider why aluminum foil fits so well into the paper folding box picture. In the first place, aluminum foil, except in the very light gages, is completely free of pinholes and, consequently, it has a moisture vapor transmission rate approaching zero. In the annealed state, which is that normally used, it is very ductile and therefore, it can be bent sharply without fracturing. It is also completely nontoxic and nonoil absorbent. With these characteristics as well as other ones mentioned previously, I feel you will all agree with me that the use of aluminum foil by the paper folding box industry has not been fully exploited in the past and that it warrants being given serious consideration in both present and future research programs. I know the aluminum foil industry will be only too glad to assist in any way possible to promote the use of foil for this purpose.

With all the diversified uses of aluminum foil-paper laminates, it is no wonder that practically the entire range of papers is required. Natural kraft papers are used where color is not a requisite but strength is essential; bonds where color, strength, and absence of taste and odor are important; papers with a similar finish to bonds but with high groundwood content where strength is not a primary requirement; lithos, when the cost will stand it, to obtain the smoothest foil surface and thus the best defined printing; tissues when a very light weight stock is desired or where wax permeability is necessary for sealing purposes; and glassines and parchment where greaseproofness is essential.

The field of aluminum foil-paper laminates is limitless, but I haven't the time to go into it further and still give you the opportunity of asking questions which I hope I can answer. However, I do have to say, though, that from chewing gum and candy wraps to cartons and folding boxes, paper-foil combinations are, as they say in California, supercolossal.

Question: Who makes equipment for spraying (hot melt) of polyethylene and/or polyethylene wax melts?

L. E. Whitmore: I think I would differentiate spraying and hot melts. Take the spraying first. There has been considerable work done, experimental work done, on the spraying of polyethylene. A company in Jersey has done a considerable amount of work and our own group has also worked on that. I think so far as our own group is concerned I can say it is not completely to our satisfaction. At the moment I think it is not feasible or even necessary to consider the spraying of polyethylene on paper, for example. It is adaptable to metal, the lining of tanks and things like that, and is reasonably serviceable. But I think for paper coating we would rule out this question of spraying. Now, so far as hot melts are concerned, I think Waldron have a man here who might be able to help us on that. I think they have done some of that work. I know that the H. B. Smith Paper Co. have developed their own machine. I can't give vou the background on it nor can I tell you who supplies that machine but I do believe it is a special machine. So far as I know there are no what you might call standard machines for hot melt coating. Essentially the operation is one of calendering a fluid or a semifluid material on the paper and that briefly is the process. So far as polyethylene wax melts are concerned, the general procedure is to modify the paraffin with polyethylene only to the point where it can be applied on or can be handled on standard wax-applying equipment. In other words, as you modify paraffin with polyethylene, viscosity is materially affected. A compromise must be made between the amount of polyethylene which is added and the molecular weight of the polyethylene such that the viscosity of the wax is not upset to the point where it will not operate on standard equipment. One more consideration is that again of compatibility. The higher molecular weight polyethylene requires higher temperatures to maintain compatibility and thereby is somewhat of a restriction generally a medium molecular weight polyethylene, and by medium I refer to one in the range of possibly 12,000 to 18,000 at a temperature which can be obtained in a wax vat, possibly 175° is used on more or less standard equipment.

Question: Why do you use the term M.V.T. when the official (TAPPI and government) designation is W.V.T.? Moisture is not always water.

M. L. Downs: Simple: a force of habit. We normally, in the industry, refer to our test as G.F.M.V.T. because we use General Foods Moisture Vapor Transmission cabinet and it is not right. It probably should be W.V.T.

Question: How do you prevent glassine and greaseproof laminated board from cracking at the score lines on 180° folds?

Mr. Downs: The simplest solution of course is don't fold it 180°. I don't know that there is any patent answer. A good folding stock of course helps as does proper scoring. You can very heavily plasticize greaseproof sheets. Some people get the impression that you can only heavily plasticize glassine sheets and that is not exactly the case as you can plasticize greaseproof sheets. The best way is to go back to your normal source of supplying that greaseproof that is cracking to see what they can do to help you.

Question: What is greatest width of 0.00035 aluminum foil available and what is the possibility of obtaining even greater widths?

A. I. Totten, Jr.: That varies some with the manufacturers. I think our greatest width is 36 inches.

The whole industry is continually working on getting wider widths particularly on these light gages. Of course if you can get it on the light gages, you can get it on the heavier gages. But I would say there is no limit to what we can go, but it is a slow, tedious process, because you have to realize it is very difficult to slit metal when it is that light a gage by itself and it is the case where you have to have wider equipment throughout your entire operation—in your rolling operations as well as through converting operations.

Question: What can be done to aluminum foil laminate liner board when converted to corrugated to take scores and creases without cracking?

Mr. Totten: When you are talking about scores and creases are you talking of expansion? The only thing that will cause it to crack is when you take it out beyond its normal elongation point which of course is not a case of cracking but a case of the foil breaking. With a heavier foil, of course, you will get more elongation than you will with a lighter foil. Of course it immediately takes the cost picture up. One of the big reasons why we actually use paper lamination is that we can produce a cheaper

product using the light-gage foil and paper than we can by going up to a heavier gage foil. Practically all the foil used for packaging purposes is completely annealed.

N. A. Petter: Who supplies H.E.C. raw materials as described in your talk?

D. R. Erickson: At the present time H.E.C. is being produced by Hercules Powder Co., that is the alkali soluble. And we expect to also be in production in another six months in Kalamazoo, Mich. But at present time the only producer of alkali solubles is Hercules Powder Co. The water soluble of course is made by Carbide & Carbon, but that is not usable in this process.

Question: What do you recommend as the best technique for laminating greaseproof with dextrine adhesive?

Mr. Downs: I don't know that there is any pat answer to that either. One way to start would be to use the lowest grease-resistant sheet which you need on the job. If you use a lower hydrated sheet it will decrease your troubles. If you can use a heavily modified oxidized or other modification of starch to raise the total solids content of your adhesive and get your water content down it helps a lot. And if you can keep your glue line as light as possible keep your board as dense as possible, and keep your runoff time between your glue application and the combining as short as possible, I think you will do the most you can possibly do when there is wrinkling or buckling in your combining operation. And of course don't attempt to handle your board stock other than flat coming off the lamination. The flatter you can keep it here the flatter your stock will remain. That will not cure all of your troubles, however.

Question: Is polyethylene as satisfactory as the special grades of cellophane for an inside liner for frozen food packages, or is the oxidation a weakness?

Mr. Whitmore: I probably am not as completely familiar with the special problems of frozen food cartons as the gentleman who wrote the question, but I don't see that the oxidation would be a weakness. If there is any oxidation, it is apparent in the application and then the board is immediately a reject and it never gets into the package. Oxidation normally is accompanied by color change too but it wouldn't be a weakness because the package would be rejected before it got there. As far as comparing it to special grades of cellophane for an inside liner, I would like to make an impartial analysis of that but it is pretty hard because after all we are a little favorable to polyethylene. I think that combinations of wax and polyethylene as used as carton coatings for frozen foods are certainly as satisfactory as cellophane and possibly a little easier to use, but I will admit that that is a question open to argument.

Question: Is there a satisfactory adhesive for polyethylene to be used on conventional folding box gluing equipment?

Mr. Whitmore: I don't know of any. There are pressure-sensitive adhesives which are quite satisfactory on polyethylene but they remain as pressure-sensitive adhesives and under continuous loading, they tend to deform. However the question might better be answered by saying that polyethylene itself is the best adhesive for polyethylene sheets and polyethylene heat-sealable joints are perfectly feasible and quite satisfactory.

Question: What is the minimum gage of foil that can be considered free of pinholes?

Mr. Totten: Actually the minimum gage of foil that can definitely be assured of being free of pinholes is 0.0015. They will naturally increase as the gage goes down.

Question: What happens to the salt used in the precipitation process?

Mr. Erickson: When the salt is applied to precipitate the H.E.C. from its liquid state to its solid state, it depends a great deal on what you are making. If it is a film, an unsupported film, we use salt such as sodium bisulphate. It has to be washed off. In the coating industry and in the printing industry for paper we use monosodium phosphate which immediately throws over to disodium phosphate or a combination of both monosodium and disodium phosphate. It just happens, luckily, that when we squeeze the excess off that very little is left, and that which is left helps us in printability and acts more or less as a plasticizer. Now of course if that were left on a board that was going to contact foods directly such as meat or cheese or things of that sort, it would either have to be washed off there might be a taste on long effect, or covered by another resin, a wash coat of a moisture vapor proofer, which would cover over the small amount of salt that is left in the coating.

Question: It seems to me that square feet per dollar is important. What is the relation of glassine cellophane, cellulose acetate on this basis—cellophane for example could be thinner than glassine and therefore would go further in yardage per pound?

Mr. Downs: When I referred to the economics of glassine greaseproof, I tried to use approximately 1-mil film. I don't believe that there are many people attempting to convert films lighter than that. The film weight won't change it too much. But glassine greaseproof today is in the 20¢ a pound range. Glassines are between 22 and 25¢ a pound and I believe cellophane is in the range of 50 to 55¢ a pound for 1 mil PT. Acetate is now, I believe, about 85¢ and film is in the range of $1.00 a pound. You might be able to get glassine greaseproof down to 20-pound basis alone; I doubt it. You might be able to get cellophane a little bit below 1 mil. I think the comparison is probably legitimately at about half the cost of the next cheapest competitive type of unsupported film.

Question: What antioxidant do you recommend for a paraffin wax-polyethylene mixture?

Mr. Whitmore: I believe I went on record as saying as far as I am concerned, and based on very limited experience, that you might do about as well without an antioxidant but since the question is specifically for an antioxidant, the only one I can think of at the moment is Deanex. However, that isn't to say there aren't others and I think that any of them which normally work for paraffin are just as satisfactory with polyethylene. I think you should go after the cause rather than try to overcome it by putting in a preventative. Actually I think considerably less difficulty will be encountered with polyethylene than is normally the case with paraffin and in the case of the other two methods of application of polyethylene I think it is not normal to use an antioxidant at all.

Question: What is the percentage solids in the precipitation coating?

Mr. Erickson: About 15% is the normal precipitating solution. It can be slightly different for use of various types of setting materials. You can use bisulphates, biphosphates, sodium bicarbonates any of those materials. Naturally they can't go up toward the saturation point but I would say in general about 15% solution is normal.

Question: Is the precipitation method of coating affected by natural moisture absorption of the paper? Would it help if the paper were water repellant?

Mr. Erickson: That is a question that is quite complicated. It comes into inks and all methods of precipitation. What I guess that the question means is: what if the paper were such that it would precipitate from the bottom up? Naturally, if the paper were coated so that it precipitated from the bottom up, there would be no penetration at all: setting from the bottom up it would have no adhesion, so you could strip the film off. Would it help if the paper were water repellent? If it were completely repellent with wax or polyethylene and you coated it over, of course there would be no adhesion and you could strip the film off again. However, it does not make much difference whether the sheet is highly sized or lowly sized. When you contact it with a caustic, such as sodium hydroxide, your sizing seems to have no effect whatsoever. We have the same penetration with water on a highly sized sheet as we do with practically no size at all. When we precipitate the film immediately after it is coated on, it seems to make no difference whether it is highly sized or not sized.

Question: What do glassine producers add to the sheet to produce the transparency on supercalendering?

Mr. Downs: Actually, we depend almost entirely on good beating characteristics, freedom from filler, and very heavy supercalendering to make it highly transparent. We can, however, increase the transparency simply by heavily plasticizing, and most of the high transparency glassine sheets have been treated with a number of types of plasticizers ranging from glycerine through sorbitol and urea combinations of one sort or another.

A. G. Imhoff: Is "so-called" glassine or greaseproof having a turpentine test of less than 30 seconds considered a commercial sheet?

Mr. Downs: A 30-second sheet is not considered a specific grade. It's possible to have grades all the way from a nongreaseproof sheet through semi to almost a completely greaseproof sheet. And it can be that somebody using a fabrication method likes a low greaseproof in a sheet because of scoring properties or because he is backing it with micro wax or one reason or another. In that sense the 30-second turpentine test is approaching a greaseproof grade that might fit his requirements very nicely.

N. A. Petter: Who makes and sells equipment for coating with polyethylene-hot melts?

Mr. Whitmore: I think I might elaborate a little bit. I think most of the people who are in the business of manufacturing calenders or similar types of equipment are interested in this problem. It frankly is not one that has been with us long enough to really have established a pattern, but I don't think I can give you a much better answer than that.

Mr. Petter: Is polyethylene used as a hot melt (say about 50% poly to 50% paraffin wax) sufficiently greaseproof when applied to folding boxboard to render it satisfactory for doughnuts, etc.?

Mr. Whitmore: That one I have to back up on a little bit because to the best of my knowledge no one has any information on 50–50 combinations of polyethylene and paraffin wax. We have run coatings 100% polyethylene and we have run coatings 10, 15, 20% polyethylene with paraffin wax but to the best of my knowledge there is very little information on those intermediate

ranges, and the reason for that is largely an economic one. In the case of paraffin we are trying to modify paraffin with a little bit of a reasonably high-priced material to impart certain characteristics where the paraffin has shortcomings or we are going over completely to 100% polyethylene and disregarding, in a sense, the cost. We are going to a high-priced sheet and we are shooting for certain characteristics which only the polyethylene has been able to give us. That intermediate range has not yet been exploited although we are doing work on various combinations leading to an answer in that field. It will be sometime before that answer is forthcoming partly because, at the moment, there is insufficient polyethylene for either of the two ranges we have already explored. The work in 50–50 combinations will go along and we hope that by the time polyethylene is reasonably available, or to put it a little more bluntly, we hope that when the day comes we have to go out and sell polyethylene, that we will have an additional tool and at that time maybe we will have an answer to the question.

Question: How may a thin aluminum foil be made permeable to moisture vapor? We need the appearance and reflectivity of foil, but need the permeable film.

Mr. Totten: First we talk about how few pinholes are in foil, then we ask how can we put pinholes in it. Let me say in connection with the pinholes first. You might get the impression that foil, when you get down to 0.00025 or 0.00035, has a lot of pin holes in it. That is not actually the case. Even when you get down to gages that low you do not have over 1 millionth of the total surface with pinholes. And usually in your subsequent operations, if you are laminating it to the paper, your aqueous adhesive covers it. If you are printing it and overcoating it, your overcoat and printing inks will cover it. Now actually even with a straight foil laminated to paper stock and imprinted and overcoated you will get about four times the protection you would get with two sheets of paper with 15 pounds of wax in between them. I know that by definite test. Now, as to your question, the only thing I can say on that is the stock would have to be perforated which can be done. As far as to how to get the holes to let the moisture through with the reflectivity of the aluminum I can't say as to how low in gage you can go. It would depend upon whether you are talking about a free foil or a laminated foil. With a laminated foil you can go all the way down to 0.00025. If it is a free foil you might have difficulty with trying to go anywhere near that low.

A. L. Ensink: What is the minimum amount of alkaline necessary to precipitate the hydroxyethylcellulose? What is the maximum tolerance?

Mr. Erickson: The material is soluble in alkali, that is, in sodium hydroxide. Hydroxyethylcellulose is a very peculiar animal inasmuch as it is only soluble in dilute sodium hydroxide. It is not soluble in potassium hydroxide or ammonium hydroxide. But it is soluble in percentages of 3 to 6% sodium hydroxide. We usually work from 4 to 5% sodium hydroxide solution. The alkali is the solvent and not the precipitator. In regard to the question "What is the maximum tolerance?" I wonder if the person who asked that means the tolerance of the alkali before it precipitates from a change in pH? Well, in changing pH it does precipitate a hydroxyethylcellulose but it does it at a very slow rate. In other words, we can take hydroxyethylcellulose in 5% caustic solution and we can dilute it with water and it will change the pH until it does precipitate. We can also increase the sodium hydroxide content and raise the pH until it precipitates. However, there is a time interval of about 18 minutes when we are precipitating with water instead of with a material like a salt, an electrolyte. The reason we happen to know that is because we are working on a process for putting it in the beater or in the headbox of the paper machine. We have been able to raise the tear strength of the paper over 100%. In that case, we wondered why it didn't precipitate all at once and why it had any effect on the tear strength of the paper. We found out that it does not precipitate all at once. It comes down very slowly with water when you do not use an electrolyte, and if you put it in the headbox and make your sheet and then dry your sheet you still do get that particular function out of it. The tolerance is 1 to 1000, diluting with water, but only for a certain length of time, about 80 minutes.

Question: After applying H.E.C. coating with reverse roll water, what mechanism is used for precipitating the coating with the acidic solution?

Mr. Erickson: Well, we have three or four types of installations at the present time. They are all using something a little bit different. The easiest way is merely to go around a roll with another revolving roll in a pan next to it and use a meniscus picking up the solution and putting it on the coated paper. We do not like to touch the coated paper with a roll because it can put streaks in it until it has set. Of course, the second it has touched it, from then on, you can put it around rolls and nothing will happen to it. It has completely lost all its tack, and you will not scratch it by rolling it over a roll. But the first application should be either poured on or put on with a meniscus-type applicator.

Question: What are the physical characteristics of oxidized polyethylene, e.g., film formation, solubility?

Mr. Whitmore: Well, the first and most noticeable characteristic is the change of color. Polyethylene as it oxidizes will go through a range of a light tan to a sort of a purple to almost dark brown to black, eventually. That is probably the most sensitive indication. The structure changes because of a decrease in the molecular weight. The chain breaks at some portion. There is a considerable formation of peroxide initially which drops off as the oxidation proceeds. It has one advantage that we use in flame spray, for example. Partially oxidized or even as the oxidation progresses the material becomes more and more adhesive so that it is possible, with controlled oxidation, to make a coating of polyethylene adhere rather well to steel. In the flame spraying gun, as the steel surface is heated, the polyethylene is fed to flame, the air stream is heated in passage to the base metal and is, subsequently, after it has landed on the metal, thrown into position in a partially oxidized state and adheres rather well. As far as solubility is concerned, I don't have any data on it. I rather imagine the solubility would be increased although there is only a slight change in solubility as you vary the molecular weight of the unoxidized polyethylene for a wide range so that it must be that change in solubility would be academic rather than measurable.

P. J. Trucano: You have met our moderator and I failed to give you his background this afternoon, Mr. Long is a graduate of Monmouth College and he did graduate work at Louisiana State. After leaving Louisiana State, he went to work with Corn Products. Then he came to work with Container Corp. of America and is now their technical director. He also represents the Folding Box Association of America in the capacity of chairman of the research and technical committee. May I present Des Long.

F. D. Long: It is a nice feeling to come here and find the room filled. We have had so many where the outer acreage was wide open. Again I would like to say the subject of grease resistance is a very pertinent subject. That is apparent when so many people are willing to go so far and spend the whole day in here discussing it. This afternoon was very heartening. I don't know when I have seen such a large audience sit attentively for three or four hours listening to technical papers. It was a great pleasure to all of us to have that kind of reception. Tonight is again a joint effort on the part of the folding box association and the Chicago section of TAPPI to sponsor this meeting. It is a rather new approach. The speakers this afternoon did a marvelous job, in my opinion. I was sorry we didn't have more time to let them talk and ramble on. Usually learn more that way. Unfortunately we couldn't do it.

Tonight we are to have two speakers—A.T. Luey, Sutherland Paper Co., Kalamazoo, Mich., and H. T. Spannuth of Wilson & Co., Chicago, Ltd. I will ask Tom to speak first.

Survey of Greaseproof Boards and Papers

A. T. Luey

The purpose of this paper is to present a general survey of the grease-resistant materials normally used in conjunction with folding paper boxes. These general surveys are always difficult from the standpoint of selection of material. Items of relatively minor importance in my opinion may be of major importance in yours. If so, that is one reason why we have the discussion period following the talks. These discussion periods are frequently the heart of the meeting. It is the time that everyone can contribute, be it a question, answer, or suggestion and in the discussion of this subject, all contributions will be greatfully accepted.

The term, grease resistant, is one normally applied to a packaging material that will resist or prevent a penetration of oils and greases. The most common example of this is a standard bakery carton with a greaseproof paper or glassine lamination. From a tonnage and dollar volume standpoint, this is the largest greaseproof item in the folding boxboard field.

Bottle cap liners requiring resistance to essential oils, or-

ganic solvents, and so forth, and paper oil cans are examples of the much more severe grease-resistant classification.

At the other extreme, we have the minor resistance required by gloss inks. This has become increasingly important over the past few years.

TEST METHODS

The most common method of evaluating grease resistance is the TAPPI Standard (T 454 m) turpentine test. This test was originally developed by the Glassine and Greaseproof Manufacturer's Association Technical Committee and later adopted as a standard by TAPPI. In this test a measured quantity of turpentine containing a red dye is poured onto a small pile of sand placed on the test specimen. The penetration time of the turpentine is noted up to a maximum of 1800 seconds. Normally, after 30 minutes, the turpentine will evaporate before it will go through the sheet. For the normal greaseproof sheet, glassine or vegetable parchment, the test is good to show pinholes as the sheet will usually exceed 1800 seconds.

TAPPI lisst several other tests in their Routine Control Methods (RC-18, 19, 52, 62, 80, 81) which deal primarily with an evaluation for gloss ink printing purposes. Of these, RC-81, frequently called the Vallandigham test, has gained considerable favor in the past few years.

The Vallandigham test consists essentially of spreading a carefully measured portion of mineral oil over the surface of the test specimen by means of a metal roller. The rate of oil penetration into the surface of the sheet is measured by the amount of light reflected from the surface after a definite time interval, usually 20 seconds. By means of this test, it is possible to have a routine check in the matter of seconds.

An "end use" test is made when some special grease resistance is required. For example, in the use of special coatings for cap liners, it is quite customary to make cap liners of the material under question and place them under various tests of the most severe conditions for prolonged periods of time. In this case, it is felt that there is virtually no limit to the severity of tests that can be applied and the expense which can be given such a test, since relatively, a few cents worth of material can end up in a position to critically affect several dollars worth of merchandise.

MATERIALS

Of the materials normally available for greaseproof packaging, we have at the head of the list, greaseproof papers, glassine, and vegetable parchment. Mr. Downs of the Thilmany Pulp & Paper Co. spoke of these materials in some detail today. These are perhaps the best known to the trade and at the present time enjoy extensive use and acceptance wherever grease-resistant packaging is required (*1*). Greaseproof paper is made from pulp which has been heated until its freeness is reduced to approximately 50 ml. Canadian standard. If beaten to a greater extent, the freeness will start to go up again because the fibers will have become so small that they will pass through the screen instead of forming a mat. Approximately five times as much horsepower per ton will be spent on beating raw stock for greaseproof paper than for the average writing paper. Obviously, this will vary with the grade of pulp used and the beating equipment. Production of a semigreaseproof sheet will call for a pulp freeness of approximately 100 ml. Canadian standard.

Here we have taken the material that is insoluble in oils and greases, i.e., cellulose fibers, and by mechanical means have made a continuous film of this material. The mechanical processing of the fiber resulting in extreme hydration makes it possible for the individual fibers to be knitted so closely together as to produce a continuous barrier of cellulose.

Glassine is prepared by dampening and supercalendering greaseproofed paper.

Vegetable parchment is prepared by passing a water leaf sheet through a bath of 65% sulphuric acid and then through a rinsing bath of water. The paper is in contact with the acid for only a few seconds and there appears to be no loss of material. The paper does not lose weight and the sulphuric acid can be reclaimed from the rinse water. The resulting paper is extremely grease resistant and in addition will not disintegrate in water. It is believed that the concentrated sulphuric acid dissolves the outer portion of the cellulose fiber and upon dilution the cellulose fiber reprecipitates resulting in a parchmentized sheet. It is further believed that an ether linkage resulting from the sulphuric acid treatment is responsible for the water-resistant qualities of the sheet. It is interesting to note that a sheet of paper will shrink approximately 10% in width upon being parchmentized, which is roughly the same amount of shrinkage that occurs when a greaseproof paper goes over the driers of a paper machine.

Parchment and some glassine and greaseproof papers will become extremely brittle on aging and must be plasticized in order to stand folding and creasing. It is quite common to use 15% glycerin to plasticize parchment while glassine and greaseproof requires smaller amounts.

A second group of materials to be considered is the regenerated cellulose derivative films such as cellophane and cellulose acetate (*2*). These are commonly used as windows in cartons. These products are produced by dissolving cellulose in a variety of solvents and reprecipitating the material as it is extruded through a slot in sheet form. Cellophane, which was an offshoot of the rayon process, is now sold by one manufacturer in over 80 different variations. Cellulose acetate is also available in many different forms. As a result, it is necessary to refer to detailed manufacturer's bulletins in order to select the particular film for a specific problem. One of the fundamental differences between these two classes of materials is that the cellulose acetate is more dimensionally stable during humidity changes and as a result, is sometimes preferred when a distortion of the film will cause packaging problems.

The precipitation of hydroxyethylcellulose into a continuous film after the material has been applied as a coating was the subject of one of the papers today by D. R. Erickson (*4*). This process was originally developed for clay coating in which the hydroxyethylcellulose was the adhesive. Its use as a grease-resistant coating is complicated by the precipitating chemicals and subsequent washing operations required if the product is to come into direct contact with foods.

A third group of materials for grease-resistant packaging is the plastic or synthetic resin films and coatings (*3*). Typical examples of these are the polyethylene bags frequently used as separate liners for frozen food cartons and latex coatings used on plates and wallpaper to make them grease resistant. This particular group of materials has probably caused more comment and stirred more interest over the past ten years than any other development of material for the paper industry.

The postwar developments in synthetic resins for use in the paper industry have been rather extensive and as a result it has been difficult to keep adequately abreast of the new developments in this field. The seemingly endless number of products offered by the chemical companies make it necessary to rely heavily upon the technical salesman in the investigation and use of these new materials. To date, however, there have been only isolated instances of commercial application of latices for coating purposes in the grease-resistant field. They have been unable to compete, except in a few special cases, with glassine and greaseproof papers due to their high cost. Nevertheless, it is quite commonly thought that this is the avenue for new development and that ultimately a new type and method of coating will be discovered that will solve this problem.

I have heard frequent comments by members of the plastic industry that the paper manufacturer appears to be looking for the magic formula of a coating material which he can apply with complete indiscretion and obtain the miracle of the ages which would be, I suppose, a snow white coating with very

high gloss, resistant to the penetration of oils, greases, and miscellaneous materials. And, on the other hand, plastic manufacturers occasionally feel that they have such magic formulas if only the paper manufacturer would have the proper equipment and be willing to operate under a few restrictions. Unfortunately, neither has realized his goal, although we occasionally hear of plastic coatings in the bakery field that appear upon the market in a limited form.

The plastic films, on the other hand, have been quite successful and we have a representative of Carbide & Carbon with us today who spoke in some detail on polyethylene films.

Even though the plastic coatings have not found universal application, at the present time, there is, nevertheless, a very keen interest in these products by the paperboard manufacturer and user. Because of this rather widespread interest, I thought it would be of value to devote a little time to a discussion of this subject.

In the "Manual of Plastics and Resins" by Schak, a polymer is described as a chemical compound composed of repeating molecular units. A copolymer is a polymer whose molecules are made up of more than one type of monomer. It is not a mixture of polymers, but a chemical compound in itself. We have several types of polymers or copolymers such as:

1. Addition polymers.
2. Condensation polymers.
3. Low polymers with 150 to 500 repeating units.
4. High polymers which have around 4000 plus repeating units

Another term very commonly used is plasticizer, which is described by R. F. Boyer in a recent paper as a solvent of a dispersed or polymeric type used to modify the intramolecular forces along a polymer chain. A plasticizer is also frequently classified as a relatively nonvolatile solvent, which acts as a "molecular lubricant." Various unsaturated organic compounds such as ethylene serve as monomers and, individually or in mixtures, they are made to polymerize and form a synthetic resin. The monomers are either polymerized in:

1. Their pure state called mass polymerization.
2. Solution form.
3. Emulsified form which produces the well-known latices.

The final product depends upon the type and variety of initial monomers, the degree of polymerization, and the addition of modifiers. Theoretically, this gives the plastic manufacturer an unlimited range of variations in his product, just as the paper manufacturer has an unlimited range in mixtures of groundwood, sulphite, and soda pulp with size, alum, clay, and starch.

The selection of a plastic for use in the paper boxboard field becomes a rather severe elimination contest. Consideration must be given such general characteristics as toxicity, odor, color, stability, plasticity with nonmigrating components, and blocking. Specific end use applications involving printing, gluing, moisture vapor resistance, also must be considered. As a result of a lot of experimental work, various types of polymers and copolymers have been developed, which seem attractive for coating purposes (*4*).

The formation of a continuous film is an interesting phenomenon particularly from a latex. In this case the dispersed phase is brought into closer and closer contact by evaporation of the continuous phase. The intramolecular forces between the colloidal particles finally break the emulsion, and the tendency of a system to assume the smallest surface area possible changes the dispersed phase into a continuous film. Quite frequently, it is necessary to have a plasticizer in the role of molecular lubricant in the production of this continuous film. Also at other times, it is necessary to assist the process by the application of heat.

The last group of materials frequently considered for grease-resistant coatings consists of natural products such as starch, casein, animal glues, alginates, and chemical variations of such items along with some synthetic large molecular compounds as methylcellulose and carboxymethycellulose. Occasionally, reports are received of coatings developed using these materials that have sufficient grease resistance for bakery cartons, but none have had a large commercial acceptance to date. Invariably, they lack some of the other necessary qualifications that generally accompany the grease-resistant specification such as water resistance, flexibility, lack of pinholes, etc.

These materials are used, however, with considerable success in application at the calender stack of the paper machine to achieve a limited resistance to the penetration of oil for use in gloss ink printing on boxboard. All of these products and undoubtedly several more are currently in use for such a purpose at the present time. The quantity of material required at the calender stack may vary with the grade of board being produced and the formation of the top liner. However, proper application of these materials will result in a sheet satisfactorily surface sized for gloss ink printing, regardless if it is a low-grade bleached Manila or a super patent coated news.

At this point, I should like to present the relative cost picture of various grease-resistant materials that can be used in making a standard bakery carton. This will show one of the present reasons of superiority of the greaseproof and glassine papers and what will have to be achieved by the coating resins from an economic standpoint if they are to compete in this highly cost-conscious field. The following figures are based upon the published sales price of the various items involved:

	Material	*Sales price*	*Cost per M sq. ft.*	*Weight, lb.*
1.	Patent coated news, 0.016	$185.00 per ton	$6.00	64
2.	Patent coated news, Manila back 0.016	217.50 per ton	7.00	64
3.	Unbleached greaseproof 30-lb. sheet	0.18 per lb.	1.80	10
4.	Bleached greaseproof 30-lb. sheet	0.20 per lb.	2.00	10
5.	Bleached glassine	0.22½ per lb.	2.25	10
6.	Vegetable parchment 30-lb. sheet	0.30 per lb.	3.00	10
7.	Wax adhesive	0.10 per lb.	0.50	5
8.	Starch adhesive	0.06 per lb.	0.24	4
9.	Cellophane	0.55 per lb. 19,500 sq. in. per lb.	4.08	7.4
10.	Cellulose acetate	0.82 per lb. (22 M sq. in. per lb.)	5.37	6.5
11.	Latex resins	0.45 per lb. solid	1.80	4
12.	Converting cost for lamination	(greaseproof laminated board $250.00 per ton 79-lb.)	0.50	...
13.	Converting cost for coating	....	1.00	...

By an examination of these figures, it is possible to roughly calculate the cost of obtaining a grease-resistant carton. For example, the normal laminated bakery carton would consist of items 1, 4, 7, and 12 plus a shrinkage factor between 8 and 10% for the loss of material during the operation. It is easily seen that it will be uneconomical to consider laminating cellophane except for some extreme application.

In considering the possibility of using a latex, first consideration must be given to the appearance of the finished carton. Since the latex coating will be colorless and transparent it is generally considered for matters of appearance that it is necessary to improve the coating surface above the quality of an ordinary news back sheet. Also, because of economies involved in material consumption in coating, it is advisable to

have a very well-formed and highly filled liner with even a coated surface being quite desirable. As a result, the minimum cost increase to be expected would entail going to a patent coated manila back board, item 2, which immediately raises the price $1.00 per M square feet. The converting cost in the coating operation will necessarily be higher because of the additional equipment invariably involved (assumed to be twice as great for purposes of estimating). As an obvious result, it is necessary to develop either a cheaper latex or one that can do the job with a much lighter coat weight.

Since it is possible to vary the coat weight of a latex from virtually zero up to a substantial figure and to vary the grease resistance obtained in a similar manner, some applications have been found which take advantage of these extremes. A coat weight of approximately $^1/_2$ pound per M square feet of latex resin will give a slight amount of grease resistance suitable for some bakery packages. This type of carton, of course, has very limited use, and it is frequently pointed out that a board with a good surface size of wax and resin emulsions, could be quite competitive because in this particular application where the grease resistance is of a minimum requirement, usually the water resistance is of major importance.

One of the main driving forces that spurs management's interest in synthetic resins or other substitutes for greaseproof paper and glassine, is the continual curl problem that we have always had with the greaseproof or glassine laminated paperboard. Periodic complaints of curl from customers through the sales department and the repeated technical explanations for our inability to avoid the curl of a greaseproof laminated board leave management with no alternative except to find some other material that is just as inexpensive and that will not curl. As a result, we have this widespread interest in all types of substitutes and coatings to take the place of greaseproofed types of papers. Personally, I feel that the answer to this problem is still in the research laboratory of both the chemical manufacturer and machinery builder. I believe we will need materials as yet undeveloped, which in addition to all of the well-recognized necessary qualifications, will give us an inexpensive film of high opacity. On the other hand, this pressure of competition will undoubtedly result in some active work by our greaseproof paper manufacturers and possibly they, too, will develop a sheet which will retain its excellent greaseproof qualities and in addition be dimensionally stable.

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F. D. Long: We thought it might be well to have a customer come in and give us his advice. We have tonight one individual who has been in the business a good many years. H. T. Spannuth of Wilson & Co., Inc., Assistant Director of Research and Technical Division here in Chicago. He is an Indiana University graduate and continued his graduate work there. Also he has gone on to the University of Chicago to take some special work. For 16 years he has worked in this particular field of research and development packaging of fatty products; Mr. Spannuth.

A Consumer's Viewpoint of Greaseproof Requirements

H. T. Spannuth

Some things aren't quite the way they seem when we first look at them. I have to make one or two confessions. My knowledge of greaseproofing is extremely limited. Whenever a purchasing agent or packaging man wanted to know something about it he would bring up a sheet of paper or something like that. Heaven knows I didn't know what it was. And he would ask a few questions. What were some of those questions? One was, is this impervious to grease. Not knowing too much about turpentine and the turpentine test, we merely took soybean oil, or corn oil, or winterized salad oil and checked to see whether it was or went through. I don't know whether it was because we always got good samples, or what but it seemed as though it didn't fail but we did find out that it would go through the seals, the corners when folded, and places like that. So we sort of got to thinking that greaseproofness was more or less finding these Achilles' heels in some of these packages. And from a customer's standpoint we went into it once in a while because the customer would tell us their shortening was no good or one of their products was no good. It went rancid. Well, being a fat expert, I am not saying a package expert, we would check into it and satisfy ourselves that they were not quite right, that the fat in the product was all right but all that was the trouble was that a little fat was rancid around the package. But that is an introduction. I will make a few comments about some items I have jotted down here.

It is generally recognized that one of the prime functions of packages is protection. Moreover, this should be done in a way consistent with acknowledged requirements of economy, convenience, sales appeal, and the usual printed message. Greaseproof materials and cartons have much to offer in these respects. We should not lose sight of this in this discussion. Another point which we should keep in mind in the next 20 minutes of discussion is the greaseproof requirement of a given type of product is not static but dynamic. Those for oleomargarine were affected by the general availability of the refrigerator in the home unit, by the legal requirements of fat, and by the legal and tax situation on the coloring. Continued vigilance should be exercised in the study of life histories of food products with their changes. This seems particularly important to this section of the package industry in view that it has so much to offer in economy, convenience, sales appeal, and printed message. I hesitate to state what some requirements are for given products. For example, in the potato chip industry in which we have done a great amount of service work, we find quite a number of packages. They go all the way from the simplest type of glassine bag to tin cans and nitrogen filling. Now what are the requirements of potato chips? I think when you see such a large extreme you will know why I sort of dodge the issue. But in the course of the discussion I hope to bring out a few points why I do duck the issue on some of these products and say I do not know just what the requirements necessarily are other than what the customer puts on from his standpoint of his experience in his trade or practice of distribution. This discussion will include consideration of the package as a barrier to grease, as a barrier to foreign odors in relation to fat deterioration in the nature of the change involved, and as a barrier to oxygen with a nitrogen filling as related to life histories of the product. As illustrated by the TAPPI turpentine test, greaseproofness is related to its effectiveness as a barrier to the passage of turpentine with time. Moreover grease is a relative term presumably meaning a nonaqueous liquid such as turpentine, mineral oils, glyceride, and other similar materials. As a first approximation of the greaseproof requirement it has been suggested that approximate analysis be used as a guide whether the product be clay, a lubricating grease, shredded coconut, or floor sweeping compound. In the case of food products one will find the U.S.E.A. Report No. 8 on the composition of 100 foods a useful reference. In the 100% fat class we find salad oils, cooking oils, lards of various descriptions, shortenings of numerous types, lubricating oils, cocoa butter, and stearine flakes. In nearly all grease items we have lubricating greases, butter, plastic cream, oleo, paste shortenings, baker margarines, and mayonnaise. With the exception of mayonnaise, I believe all those are over 80% fat. In the enriched fat foods we have roasted nuts, potato chips, doughnuts, French fried foods,

popcorn, peanut butter, salad dressing, pie crust, pie crust premixes, dried egg, dried whole milk, powdered shortening, cheese, liver sausage, certain meat spreads, bacon, ham, whipped cream, pork sausage, pork chops, and related products. In the class of butter and fat level, we find cake and biscuit premixes, crackers and cookies, pound and layer cakes, fudges, and caramels, ice cream, dried soups, and some fowl, fish, and meat products. There are relatively few food products which do not contain some fats which may absorb odors or deteriorate. It can readily be seen that the usefulness of the approximate analysis of the grease content is limited. One hundred per cent lard flakes can be packaged in a cloth or paper bag, barrels, or cardboard boxes, while salad oil requires a liquid type container. Both of these products are 100% fat. Shortening and lards represent varying degrees between these two extremes of the lard flakes. Lard flake by the way is nothing more than hydrogenating lard to the extent it would take the hydrogen and you get a high melting point material, about 140°F. In the prototype of all visible shortening, 85% cottonseed oil is stiffened with 15% hydrogenated cottonseed oil stearine. Moreover, the amount of free oil which can be pressed out of a lard or shortening is dependent upon the way the fat was chilled down from a liquid. In a lard or a shortening and in fats in general only about 25% of the constituents are actually solid at room temperature. The amount changes considerably as the temperature is raised or lowered. Bailey's book on "Industrial Fat Products" gives various graphs showing how the liquid component varies with the temperature for various specimens of oils and fats such as lard, coconut oil, butter, cocoa butter, vegetable shortening, and margarine fats. Landroc and Proctor measure the free oil by extracting the absorbed fat from blotting paper. Some of the factors considered for pie mixes were the weight of sample, the larger the weight of sample, the more oil is soaked into the blotter; the relative humidity; effect at 100°; the variation of the temperature on 2 days' exposure time; the effect of time up to 7 days; and the effect of the fat content in the mix. Data were presented for free fat for a number of food products with 30 to 90% relative humidity. More quantity studies of this general type are needed. If you are not familiar with this work you probably would find it a useful reference to review.

Metal parts which have been oiled or rustproofed illustrate where per cent of grease to weight is of no importance and the per cent grease by area is the better guide. In the case of food products, one frequently encounters coated products, chocolate, and other coated ice cream and frozen bars usually contain 50 to 60% of oil or fat. Candies, peanuts, cookies, and even doughnuts may be coated completely or partially with preparations containing 30% fat. Such products illustrate not only the importance of the fat content in surface layer in contrasted products as a whole but also the melting point of the fat. For example, chocolate coatings have snap to them due to the fact that there is an unusually large percentage of the fat actually solidified, and the way the coating was tempered and set up in the chill tunnel. Those are the variables that have involved most of my time and not so much the matter of actually developing the package.

In considering the above products we are impressed by the limitations to the value of approximate analysis and the importance of the freeness of the oil. In considering the grease-air aspect of package protection we should consider more than the ability of the sheet to prevent the passage of turpentine through the sheet. Lalers has illustrated this in his comparative study of package materials. Those of us who have worked with shortening containers know that the corners are one of the Achilles' heels. The parchment or greaseproof liner and the folding closures are others. It also illustrates the package machine problem of filling the cartons at a rapid rate without dripping and smearing. This is important not only from the standpoint of grease stain but also of fat deterioration. Where stains cannot be completely avoided and they aren't completely avoided in many cases, design can be such as to conceal it to a degree. Now that can only be done satisfactorily in a case where the shelf life is rather limited and the rancidity problem is of not too much concern. Structural strength and rigidity are important aspects of the fiber box so as to minimize the pressing out of the free oil. In the product life cycle all too frequently products are stacked too high particularly when the product is at an elevated temperature. This is particularly true of shortening and is serious for margarine. Modern margarine or oleomargarine is manufactured with a low melting point with the expectation that it will be kept under refrigeration. All of us I am sure have seen it stacked up in hot self-service stores. The fiber box helps to keep the heat out so that the product can be gotten home and put into a refrigerator before it melts and squeezes out of the package. High-grade chocolate-coated candies and cookies are other examples of the compromise between package and storage problems with eating qualities.

Another approach to the greaseproof requirements of a product is to study by comparison and contrast its characteristics and life histories with related products. One is sometimes surprised by the extent of work on such products of high volume and large production. Some of these scrap heaps of data and experience and some of the advanced thinking data of things to come are valuable, particularly in the choice of most economical package or in searching for a substitute in case of lack of the available supplies. Package data for butter have been valuable for oleomargarine. Package experience for prepared pie crust mixes has been valuable for cake and biscuit mixes. Snack items such as popcorn, popped bacon rinds, and corn curls can borrow from the experience of the potato chip industry. Incidentally, much of the information on the potato chip problem is published in the *Potato Chipper* of the National Potato Chip Institute. The Quartermaster Food and Container Institute has some booklets on food products which have some help as they describe common accepted packaging procedures and indicate the storage conditions and also the storage life under those conditions. Some data can be secured from the Refrigerating Engineers' Handbook as to the normal holding temperatures and length of holding. These comments are made from the viewpoint of studying the problem of fat rancidity to decide if that is a problem or not a problem or whether it is merely a matter of the stain and the visual appearance which one observes. The per cent of fat in a food suggests the possibility of absorbed odors. Odoriferous substances are oil soluble. This property has been utilized, particularly in France, in captivating delicate perfumes. In soap we want the perfumes locked in. In food we want them locked out and sometimes we want them locked in. The terms used by the butter grader bear testimony to the need of such protection. They fully recognize the fact that the cream as it has been brought in from the barns to the consumer has many opportunities of absorbing odors. Lots of butter are stored for 6 to 9 months from the period of excess milk production in the Spring to be used later in the year. In the case of popcorn, for example, we have what we call French popping and we call the oil or shortening used seasoning. Actually the fat is bland, no flavor odor at all, and if it did have an odor it would be volatilized at the high temperature at which it is heated for popping the corn. But as the popcorn pops, the oil catches the aroma and helps to maintain its good flavor. Incidentally, the popcorn oftentimes contains 25 to 35% fat, and it is quite a greasy proposition. I think you have all seen the soaky bags that are handed out in many cases.

Many trends in food processing have and still will continue to place more emphasis on the phase of fat protection in packaging using greaseproof materials and folding boxes. As other problems of protection are solved the fat deterioration problem becomes a more practical consideration. Frozen fat deterioration in frozen meat follows the solving of the stoppage of other types of spoilage, such as loss of moisture and color

changes. Shelf life of fat in doughnuts is not much of a problem because they dry out too fast and no one would eat them. Fats deteriorate through oxidation. What is the nature of this change? They may become rancid or they may revert. Recently I reviewed this subject at the short course given by the American Oil Chemists Society at the University of Illinois. Reference can be found in the *Journal* of the American Oil Chemists Society. Since rancidity development is associated with the oxidation of fats, oxygen must be present at some stage. The reaction is accelerated about two times for each 18° F. rise in temperature. With a little mathematics you can sort of figure out the rates of deterioration at various temperatures, other things being equal.

The phenomena can best be studied by controlling rigidly the various factors and varying each separately in such a way which cannot be done in the field or with the usual package product, or if so, only with great difficulty and expense. The method we use of testing the proneness to oxidation is to put about 20 grams fat in a tube and bubble air through it holding the temperature at 208°F. in the dark. Using such a system you encounter a long period when no change is observed by smell; no change is observed by running what we used to call a peroxide value. Then after a while the odor starts to develop and the peroxide rises very steeply. In other words the curve would go along the abscissa and then rise abruptly. The flat portion is called the induction period. The fast part we call the auto-oxidation period. In other words, the presence of the rancid fat accelerates the oxidation of the other fats. When peroxide forms one doesn't taste it, but as the peroxide decomposes, you have the rancid products, the part that you taste or smell. The induction period can be shortened tremendously by the presence of a little metal. It can be shortened by the presence of a little rancid fat. If you add antioxidants that induction period can be extended. The reason for discussing the factors involved in fat deterioration is that in my experience with long shelf-life articles, you encounter off odors, and the person who has not had the background and training experience is sometimes confused with trying to judge or compare or analyze just what is happening. In other words, we remember that the fat can absorb off odors. If off odors develop as in some mixes which have dried eggs or flour or something or other so that the odor goes from the protein fraction over into the fat fraction, the person starts to taste it and oftentimes call it rancid but from the fat chemist's standpoint we sometimes say the fat is not yet rancid. There are numerous cases on record in which the fat is called rancid and objectionable. Some of those changes, if they have developed from a small amount of fat being oxidized, are called reversion. To illustrate the point, we stored some lard for two or three years at low temperatures in 400-pound drums. The lard proper was good and fresh but in about 18 months there would be a low corner where the fat went rancid much like an apple going rancid or spoiling in one spot. In some of our packages we have that type of reaction. In other words you have local spoilage and that spoilage and that odor permeate through the package. And to us grease soakage is particularly bad in long shelf-life articles because that is the place where the rancidity problem sets in. It has been said, that rancid prepared mixes are never encountered without having the rancidity occur first in the package.

Only certain portions of the fat molecules have the proneness to oxidize and in our work we hydrogenate those particular more readily oxidized components out. In certain products, however, it is not practical to do that, so that other methods of protection have to be applied. In some shortening we add antioxidants; there are about half a dozen or dozen approved by the Meat Inspection Division. In the case of the meat fats, they are notoriously free of antioxidants and there is no good convenient way of incorporating the antioxidants into the fat in the tissue.

Going back for a moment to the matter of packages where we have difficulty frequently it is caused by an insert. It may be board placed for support or it may be dividers in a cookie box or it may be an insert advertisement. Perhaps some of you have seen the shortening can with a piece of paper put in on top of the shortening in a hermetically sealed can. The ink and the paper sometimes give difficulty. In our work, we check the life of products by storing them at 104 and 190°F. and determine, at the end of the induction period, the quality of the food. We take the package and we take the various parts. We place some of these parts carefully cut up, taking a great deal of pains to have everything scrupulously clean chemically, and we immerse them in 20 grams of oil. Then we can either smell the fat to see whether it goes bad or we can actually run a peroxide value by chemical method, an objective test. If the paper is more or less inert, the induction period remains the same. If it has peroxide effect, the induction is reduced very substantially.

We sometimes think of the tin can as a perfect container. But we consistently observe that in the south in the summer when we package lard products which have not been stiffened with stearine, that the fiber box which goes around the tin for shipping becomes oil soaked. The tin does not hold the free oil that oozes out. On one particular product when we wanted to keep the temperature point low and we wanted to ship it through the south, we put an oilproof bag inside the tin and a cardboard carton on the outside. I merely mention that because that illustrates some of the difficulties we encounter. We have had some experience in packaging lard and different type products. Before the war we had a telescopic type of square lard container which was developed with considerable cost, and the materials were not available at the time of World War II. And in World War II we went to these paper cups rather than tin cans or glass as tin was not available. In most of those cases it was a matter of percentage failures. It wasn't that you couldn't do the job, it was just that you couldn't bat a high average all the time. And most of our experience has been a good deal on the matter of percentage.

In completely protecting a fat product, one would have to exclude the oxygen before it was packaged, probably blanket it with nitrogen, and then seal it with inert gas in a liquid-type or oil-type closure. I think you see that there are quite a few variations between what we are doing in practice and what would be the complete solution to the problem. I think if you would take a complete solution to the problem and take it to some of your customers, they would not be too anxious to take it and use it. The cost is quite an item, and the usual procedure is to make comparisons from one package to the other.

In summary, I would like to leave with you a thought of improving greaseproofness in the trade by concentrating on the weak areas of corners, closures, and structural support to prevent pressing out of the oil. Care should be exercised to block out objectionable odors and have material exhibit no peroxide effect. Study the life histories of the product as to what are the controlling factors of each product. Consider carefully the economic angle while studying hermetically sealed packages and nitrogen filling. Keep the light exposure to a minimum. For example, with potato chips light exposure is very bad as it is also for other fats since it causes them to deteriorate. In the potato chip industry, some companies operate in quite a few states. They package the chips in a cardboard carton away from light and then place the bag on disposal display for only a few days to minimize the amount of light exposure. The sales department will insist on these windows because of the appeal and we have to learn to get along with them.

In closing, I would like to mention that the outline in the booklet on glassine and greaseproof papers gives some indication of the requirements, but it does not cover the problems which have been mentioned here regarding the protection of the odor and the fat deterioration.

I think that in some of these requirements we will have to

analyze them and figure out the weak links as some customers handle their products one way and others handle theirs another way. We will have to learn the histories and their weak links from which more data can be obtained in the laboratories.

Question: How much water resistance is necessary in a grease-resistant coating on paperboard to produce a satisfactory carton for packaging such bakery goods as doughnuts and Brown'n Serve rolls?

Mr. Luey: As the previous speaker pointed out, the specifications that are laid down for any package seem to vary from one extreme to another depending upon the company that is buying the carton. One package that was developed at one time was submitted to two different bakery houses for the purpose of packaging doughnuts, one came back and said it was fine in every respect except the grease spotted through just a little too much. The second one came back and said it was fine in every respect except that it was not quite good enough from the standpoint of moisture vapor transmission; the oil resistance was fine. In this business of water resistance for Brown'n Serve rolls I don't know how to answer your question except to say that it would require a high degree of sizing. A Cobb size test probably in the neighborhood of about 0.3 gram at a 2-minute exposure would be satisfactory.

Question: What is the comparative grease resistance for surface waxing of: (1) paraffin wax, (2) microcrystalline wax, (3) paraffin fortified with relatively small amounts of polyethylene?

Mr. Whitmore: I don't know the answer. In regard to the third question I think that the paraffin would probably not be greatly improved so far as its resistance to grease is concerned by the addition of 10 or 15% of polyethylene. The polyethylene is added primarily to raise the block point, improve the appearance, give a better seal strength, and make it a little bit more flexible. Frankly, I recall no laboratory data which would indicate a change in its grease resistance.

Question: What do you consider to be the best available type of package for sliced bacon with particular reference to materials?

Mr. Spannuth: The sales department wants the bacon visible so that it must have a window regardless of what else. Now, second, the base board or stiff board has to be resistant to oil soakage and must retain the moisture. We encounter difficulty from the standpoint of loss of weight. I think that you realize that all packages are stamped and if the grease or moisture soaks into the board or if you lose it someone picks off the pieces of bacon and weighs them and you are short weight. Another point is that there must not be anything there to promote oxidation. The method of packaging in handling bacon is such that you are near the end of your oxidation period. I do not have the specifications for our materials that we use for sliced bacon but I am sure any of you could pick up a sample of our brand and check them because that is what we consider the best at the present time.

Question: Is the ash content of a given metal, such as copper, indicative of the peroxide effect to be expected?

Mr. Spannuth: Metals are as bad as salt but they can be complex and become inoperative or nonactive which is one reason why it is rather hard to analyze the matter of metal activity. The content of copper is not a measure of the effect upon accelerating the rate of oxidation.

Question: Is wet strength a dominant factor in selection of certain papers for meat products?

Mr. Spannuth: Wet strength is important in packaging meat products. It must stand the moisture that is in contact. When some of your products in deep freezers are brought out in humid rooms they become moist. They can also become moist from the meat or from the fluid that comes out of the meat—the juice. The blotting type of papers can pick up some of that juice to minimize it but it must have wet strength.

Question: Is it possible to obtain sufficient moisture vapor protection with aluminum foil or other films in a sealed end folding carton to package a very hygroscopic material without deterioration over a 30-day period in moist humid climate?

Mr. Totten: I would say that is primarily based on how well you can seal the end of the folding carton. If you have your carton lined with foil and you are sealing the end with a foil tape, I will say the answer to that is yes. You can certainly provide the protection for a hygroscopic material by lining with foil, but you can't have an open end any place and still protect it.

Question: In all of our discussion, the use of Zein as a greaseproofing agent has not been mentioned. What is the practical experience in the use of this material as a greaseproofing agent on paperboard? Is it practical? Why is it not more widely used?

Mr. Luey: The use of Zein as a greaseproofing agent was not mentioned because I tried to avoid the use of trade names of material in my talk. I would classify Zein along, in general, with other protein materials that can be obtained and have been used to some extent to make greaseproof coatings. One of the principal difficulties of making greaseproof coatings of this classification has been the fact that water resistance, flexibility, and grease resistance have not been simultaneously available. I say water resistant because in packaging most bakery cartons have to have it to a limited degree so that the product will not soften in contact with a moist article, and flexibility because in normal manufacturing it is necessary in scoring. There have been coatings of zein or similar materials on the market on occasion which have done a fairly creditable job for carton applications in which a high degree of grease resistance is not required. To my knowledge the use of zein or casein or other proteins is not extensive at the present time.

Question: How do you prevent oil penetration into the cut edges of a folding carton or tray where an oily product is in contact with the edge?

Mr. Luey: You don't.

Question: Does deep freezing of meat prevent the oxidation of fat?

Mr. Spannuth: The deep freezing of meat does not arrest the oxidation of fat. As a matter of fact it protects the meat so that it can be held sufficiently long so that you may encounter fat oxidation. That is an illustration of why you encounter new problems as you improve your methods of storing and handling. I might add here that in our work we have been told and advised that fat deterioration was the cause of lots of certain meat products spoiling. When we designed our experiments and started working on them we had to admit that some of the flavors and so forth which had passed over into the fat phase and were judged by some of the handlers as off were from other origins. This suggests that although, at times, the fat may become oxidized you have other chemical changes too which are more or less setting the storage limit.

Question: Do meat fats contain natural antioxidants?

Mr. Spannuth: The meat fats, in general, are characterized by the absence of antioxidants. The vegetable fats do contain antioxidants in very large amounts. That, of course, creates some problems in some of storage. In the older methods of curing meats, such as smoked bacon and smoked ham, the smoke itself contained antioxidants which went into the fat and helped preserve them.

Question: In ham wraps are you getting away from using gray ham rag paper in favor of other greaseproof paper wraps?

Mr. Spannuth: We still use the gray ham rag papers in addition to some of the greaseproof types.

Question: In prepackaged meats and bacon have you made any experiments using polyethylenes as a substitute for cellophane and with what result?

Mr. Spannuth: I am sorry to say that work is done by another section with which I am not acquainted.

Mr. Whitmore: I don't remember the exact details but I know we have had an inquiry very similar to that from several meat packaging concerns over a period of several years. I think it is generally felt that polyethylene, if it could be properly applied in an economical coating weight, would serve a useful function. Whether it would be complete, nobody yet knows. But I think the problem has resolved itself to one of application and so far we haven't solved that yet.

Question: If the inside liner of a frozen food package will permit the free flow of oxygen, does this mean that in the packaging of foods which have a high fat content you are more apt to develop rancidity than in one which has a liner that will not permit the penetration of oxygen, or does the below freezing temperature eliminate the possibility of rancidity developing, despite the particular characteristics of the liner? This is in reference to polyethylene versus cellophane.

Mr. Spannuth: I cannot answer that from direct experience but from analogy I may be able to throw some light on it. It is rather difficult to package food products such as ham in a way which will prevent oxygen from entering to have some oxidation. Now that is the point I was trying to emphasize a little bit before that if you can avoid prooxidants and if you check your storage time and temperature sometimes you can figure back as to whether or not the cutting out of the oxygen would solve the problem. Personally I am a little bit skeptical that supplying oxygen barrier would give you satisfaction. As a matter of fact, I am pretty confident that it would not completely answer it. Now as you solve some of the other problems it is likely that oxygen barrier may give some protection so that you do not have extreme cases of spoilage. You have more or less taint, but the public, in general, will not accept a product with a certain amount of taint. The problem is to reduce the amount of oxygen so completely that you do not have a bit of that. In the problem of fat deterioration, you do not have to have very much oxygen present to permit some spoilage in that respect.

MR. LONG: The hour is getting very late and I think we should bring this meeting to a close. On behalf of the Chicago Section of TAPPI and the Folding Box Association, I wish to thank the speakers for their participation.

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EMPLOYMENT SERVICE

Positions Open

P185-52. Chemical Engineer. For specialty mill in the Miami Valley. Prefer man with paper mill experience to conduct and supervise mill trials, routine and control tests. In replying state complete history and salary required.

P186-52. Chemist. Graduate or equivalent experience for development and control work in plastic coating division of an established paper manufacturer in the Miami Valley. Good starting salary—vacation with pay—hospital care, group insurance, and other employee benefits.

P188-52. Salesman, oils—waxes—chemicals, for paper, pharmaceutical, cosmetic, and miscellaneous industrial uses; technical knowledge or experience in paper industry preferable; will pay straight salary, furnish car, and pay full traveling expenses; large, well-established and progressive company. Important apply in complete detail.

P189-52. Papermaking or chemical engineering graduate 28–40 years old with 5–7 years' technical experience in paperboard. Man selected will be responsible for supervision of testing laboratory and process development work in a progessive midwestern board mill and converting plant. Give complete background of education, experience, and salary requirements, along with recent photograph.

Positions Wanted

E159-52. Graduate Pulp and Paper Chemist. Fifteen years' diversified experience. Seeking position as technical assistant to manager of progressive board, paper, or roofing felt mill. Résumé and references upon request.

UNITED STATES PATENTS ON PAPERMAKING

Third Quarter, 1951

Compiled by CLARENCE J. WEST

THE following list of United States patents has been compiled from the current numbers of the Official Gazette of the United States Patent Office. Because, as a rule, only one claim is published in the Gazette, it is not claimed that the list is complete; also, it is possible that the list may contain some patents that do not apply specifically to pulp and paper manufacture.

Copies of any of the following patents can be obtained from the United States Patent Office, Washington 25, D. C., by sending twenty-five cents for each patent desired.

July 3, 1951

2,558,773. Apparatus for controlling the thickness of a coating on a traveling web. Lorne B. Mulloy and Robert H. Thompson, assignors to The Haloid Co., Rochester, N. Y. Filed March 6, 1948. 4 claims. (Cl. 91-10.) A roll-coating apparatus, designed for the coating of photographic papers, has a doctor roll to control the thickness of the coating.

2,558,780. Tobacco pouch and method of making same. Thomas E. Piazze, assignor to Shellmar Products Corp., Mount Vernon, Ohio. Filed Aug. 11, 1945. 14 claims. (Cl. 229-80.) A layer of Pliofilm or cellophane is laminated to a glassine web by means of a microcrystalline wax.

2,558,918. Lined carton. Julius A. Zinn, Jr., Chicago, Ill. Filed July 2, 1948. 5 claims. (Cl. 229-37.) A lined carton for fine-grain or liquid material.

2,558,940. Container. Robert M. Dunning, assignor to Waldorf Paper Products Co., St. Paul, Minn. Filed May 16, 1946. 7 claims. (Cl. 229-52.) A container for bottled goods which has a special handhold.

2,559,043. Starch adhesive sheet material and composition therefor. Leonard R. Nestor, assignor to Minnesota Mining & Manufacturing Co., St. Paul, Minn. Filed Nov. 26, 1947. 7 claims. (Cl. 106-213.) A gummed paper tape is coated with a composition containing 46.1% potato starch, 6.8% sodium hypochlorite solution, 9.2% 50%-sodium hydroxide, and 37.9% water.

2,559,101. Frozen food package. Frank A. Wool, San Jose, Calif. Filed Aug. 13, 1945. 6 claims. (Cl. 99-171.) A waxed cardboard container for frozen foods and method of sealing.

2,559,109. Laminated sheet material for packaging moisture-containing foods. John H. Bonini, assignor to Marathon Corp., Rothschild, Wis. Filed March 15, 1946. 5 claims. (Cl. 154-50.) A material for packaging meats, frozen foods, and the like consists of an inner layer of glassine, an intermediate multi-ply layer of creped tissue or wadding, and an outer layer of vegetable parchment, greaseproof paper, or the like suitably bonded together.

2,559,175. Spot glue applicator for carton making machines. Henry V. H. Stoever, Jr., assignor to The American Tobacco Co., Durham, N. C. Filed Dec. 3, 1948. 9 claims. (Cl. 91-50.) A high-speed adhesive-applying mechanism.

2,559,202. Liquid container with extensible spout. Louise A. Sherry, New York, N. Y. Filed April 14, 1949. 2 claims. (Cl. 229-7.) A waxed paper milk and cream container.

2,559,220. Manufacture of cellulose products of improved wet strength. Charles S. Maxwell and Chester G. Landes, assignors to American Cyanamid Co., New York, N. Y. Filed July 31, 1942. 7 claims. (Cl. 92-3.) A paper stock is treated with a cationic melamine-formaldehyde resin; a relatively dilute resin solution can be employed.

2,559,221. Manufacture of wet strength paper. Charles S. Maxwell and Chester G. Landes, assignors to American Cyanamid Co., New York, N. Y. Filed June 28, 1947. 5 claims. (Cl. 92-21.) Pulp in water containing from 50 to 150 p.p.m. of dissolved sulphate ion is treated with a cationic melamine-formaldehyde resin and formed into paper.

2,559,234. Process of treating paper. John T. Stearn, Brooklyn, N. Y. Filed Feb. 16, 1945. 1 claim. (Cl. 117-155.) The dimensional stability of paper is improved by impregnation with the reaction product from 1.5 to 2 moles of formaldehyde and one mole of thiourea.

2,559,305. Manufacture of tanning substances. Michael Mangold, Frankenau, and Fritz Neuber, Vienna, Austria. Filed Feb. 20, 1948. 6 claims. (Cl. 260-124.) Spent sulphite liquor (30° Bé.) is treated with a 60% caustic alkali solution, heated several hours at 60 to 100 °C., and then treated with hydrochloric acid.

2,559,320. Container having cover locking means. Fred L. Rushing and Benjamin M. Williams, assignors to Gaylord Container Corp., St. Louis, Mo. Filed March 14, 1946. 2 claims. (Cl. 229–43.) A corrugated shipping container has a slip cover which automatically locks to the body.

2,559,368. Bag forming and sealing machine. Frank J. Pancratz, Park Ridge, Ill. Filed May 12, 1947. 12 claims. (Cl. 226-56.)

2,559,374. Carrier with interlocking partition elements. William A. Ringler, assignor to The Gardner Board and Carton Co., Middletown, Ohio. Filed May 7, 1949. 4 claims. (Cl. 229-28.) A boxboard bottle carrier is fully partitioned transversely and longitudinally.

2,559,398. Wax compositions and method of making same. Robert G. Capell, assignor to Gulf Research and Development Co., Pittsburgh, Pa. Filed Dec. 16, 1948. 13 claims. (Cl. 106-272.) A wax for wrapping paper and the like contains 0.1 to 5% of dimethyldicetylammonium bentonite or like compound in a petroleum wax.

2,559,543. Apparatus for the manufacture of brick siding. Carl G. Muench, assignor to The Celotex Corp., Chicago, Ill. Filed July 10, 1948. 7 claims. (Cl. 91-43.) An apparatus for coating insulated brick siding.

2,559,552. Golf club box. Charles D. Welshenbach, assignor to The Hinde & Dauch Paper Co., Sandusky, Ohio. Filed Sept. 22, 1949. 7 claims. (Cl. 206-65.)

July 10, 1951

2,559,608. Multicolor carbon paper. Joseph R. Ehrlich, New York, N. Y. Filed Nov. 26, 1948. 5 claims. (Cl. 282-28.) A multicolor carbon paper yields copies, the color of which can be altered by chemical treatment.

2,559,610. Planographic printing plate and treatment thereof. Frederick H. Frost, assignor to S. D. Warren Co., Boston, Mass. Filed Dec. 12, 1947. 5 claims. (Cl. 101-149.2.) A method of forming a paper-base planographic printing plate with a hydrophilic printing surface.

2,559,776. Combined letter sheet and return postal card or envelope. Samuel R. Larzelere, Laurel Springs, N. J. Filed June 23, 1950. 2 claims. (Cl. 229-92.1.)

2,559,873. Machine for and method of manufacturing valve bags. William F. Grupe and Arthur P. Bamford, assignors to Arkell & Smiths, Canajoharie, N. Y. Filed Oct. 19, 1944. 12 claims. (Cl. 93-8.) The machine manufactures multi-ply valve bags in which a filling sleeve extends through the valve opening.

2,559,879. Method of making asphalt covering units. John B. Kalin, assignor to Johns-Manville Corp., New York, N. Y. Filed Jan. 31, 1945. 7 claims. (Cl. 117-5.) A method of coating shingles with asphalt.

2,559,901. Coating for paper and method of production, Louis J. Scheid, assignor to Watervliet Paper Co., Watervliet, Mich. Filed Feb. 6, 1947. 8 claims. (Cl. 106-154.) The coating is formed from clay and an enzyme-converted soybean flour.

2,559,930. Pallet. Philip S. Bolton and Joseph J. Aid, assignors to Robert Gair Co., Inc., New York, N. Y. Filed Oct. 22, 1946. 2 claims. (Cl. 248-120.) The construction of a paper pallet is described.

2,559,945. Pulp molding machine. Merle P. Chaplin, assignor to Chaplin Corp., South Portland, Me. Filed Nov. 1, 1946. 9 claims. (Cl. 92-57.) The machine incorporates stepping and locking mechanisms which operate in conjunction with forming and drying dies.

2,559,948. Carton for cylindrical objects. Grover C. Currie, assignor to Dacam Corp., Charlotte, N. C. Filed Aug. 2, 1949. 5 claims. (Cl. 224-45.) A collapsible cardboard carrier for cans.

2,560,016. Method of and means for producing milk of lime and for causticizing green liquor. Robert S. Walker, assignor to Traylor Engineering and Manufacturing Co., Allentown, Pa. Filed Jan. 5, 1948. 4 claims. (Cl. 23-188.) The lime and slaking liquid are mixed ahead of the slaker; the material may be fed through the slaker more rapidly.

2,560,249. Molded pulp corner protector. Arthur H. Risch,

assignor to Pulp Reproduction Co., Milwaukee, Wis. Filed Dec. 23, 1948. 3 claims. (Cl. 206-46.) A corner-protecting pad is formed from molded pulp.

2,560,315. Machine for assembling box blanks. Louis Triolo, Brooklyn, N. Y. Filed Aug. 4, 1949. 10 claims. (Cl. 154-1.8.)

2,560,317. Methods of determining the concentration of a chemical constituent of a fluid. Charles F. Wallace, assignor to Wallace & Tiernan Products, Inc., Belleville, N. J. Filed Feb. 27, 1946. 8 claims. (Cl. 23-230.) Method for the determination of chlorine in untreated and chlorinated streams.

2,560,402. Egg packing material. Torris H. Alfreds, assignor to Mapes Consolidated Manufacturing Co., Griffith, Ind. Filed Dec. 7, 1946. 5 claims. (Cl. 217-34.) A molded pulp packaging material is used in an egg case.

2,560,405. Apparatus for setting up cartons. Leonard Back, assignor to The Interstate Folding Box Co., Middletown, Ohio. Filed March 30, 1949. 18 claims. (Cl. 93-51.) Apparatus for erection of one-piece frozen food cartons.

2,560,521. Process of producing water-repellent gypsum sheathing board. Thomas P. Camp, assignor to United States Gypsum Co., Chicago, Ill. Filed May 10, 1946. 3 claims. (Cl. 154-86.) The board is provided with water-resistant rosin-sized, petrolatum-coated paper liners and an intermediate paraffin-impregnated gypsum core.

July 17, 1951

2,560,535. Tobacco pouch. Howard G. Allen, assignor to American Machine & Foundry Co., New York, N. Y. Filed March 5, 1946. 2 claims. (Cl. 229-76.) The pouch is formed of paper, cellophane, or rubber hydrochloride.

2,560,572. Method of coating paper. Gerald Haywood and Charles S. Dayton, assignors to West Virginia Pulp and Paper Co., New York, N. Y. Filed June 25, 1946. 3 claims. (Cl. 117-111.) A method is covered for coating and drying book and magazine papers.

2,560,638. Manufacture of cellulose. Henry Dreyfus, assignor to Celanese Corp. of America, New York, N. Y. Filed Oct 3, 1945. 8 claims. (Cl. 92-16.) Straw is cooked with 1% sodium hydroxide for 1 hour and then refluxed 5 hours with 90% ethyl alcohol containing 1% hydrochloric acid; it is boiled an additional hour with 1% sodium hydroxide.

2,560,847. Molded fiber article. Merle P. Chaplin, assignor to Chaplin Corp., South Portland, Me. Filed June 3, 1947. 8 claims (Cl. 229-2.5.) A molded pulp egg carton with cross-bracing ribs.

2,560,916. Cement for laminating sheets of paper or like materials. Philip S. Barnhart and John C. Miller, assignors to Westfield River Paper Co., Inc., Russell, Mass. Filed Sept. 8, 1945. 2 claims. (Cl. 260-27.) The cement contains more than 50% of a microcrystalline wax and 0.5–20% of a plasticizer. It also contains 1–25% of polyisobutylene and a resin.

2,560,927. Handled cup or like receptacle. Kenneth T. Buttery and Louis W. Sutherland, Jr., assignors to Sutherland Paper Co., Kalamazoo, Mich. Filed April 16, 1947. 6 claims. (Cl. 229-4.5.) The handle may be collapsed against the side of the cup.

2,561,013. Apparatus for thickening pulp. James T. Coghill and Howard H. Langdon, assignors to Consolidated Machine Tool Corp., Rochester, N. Y. Filed Sept. 6, 1947. 20 claims. (Cl. 92-26.) A pulp thickener is designed to dewater pulp rapidly and efficiently from consistencies of 2–4% to 10–35%.

2,561,053. Garment container. Clifford D. Fallert, assignor to Gaylord Container Corp., St. Louis, Mo. Filed June 11, 1949. 9 claims. (Cl. 206-7.) A one-piece, folded-blank paperboard container with top-forming portions for garment hangers.

2,561,150. Process for making tall oil. Raymond W. Stephenson, assignor to Kirby Chemical Co., Inc., Severn, N. C. Filed Sept. 3, 1948. 14 claims. (Cl. 260-97.7). Tall oil soap is floated on 30% aqueous sulphuric acid and heated by injection of steam at 50 to 100 p.s.i. until the liberated tall oil has an acid number of at least 170.

2,561,260. Packing swing. Daniel M. Yaupp, Chicago, Ill. Filed Oct. 28, 1947. 3 claims. (Cl. 229-42.) A packing swing is adapted to shipping cartons for radios, dishes, and the like.

2,561,262. Cup for refrigerated commodities. Adam Ziska, assignor to Samuel M. Kaufman, Milwaukee, Wis. Filed May 31, 1946. 4 claims. (Cl. 229-5.5.) The bottom of a paper ice cream cup is provided with a single central projection to contact the cover of a similar cup stacked below it.

July 24, 1951

R23,395. Granular coated webs and method of making same. Romie L. Melton, Raymond C. Benner, and Henry P. Kirchner, assignors to The Carborundum Co., Niagara Falls, N. Y. Original No. 2,201,194, dated May 21, 1940. Filed Aug. 13, 1945. 18 claims. (Cl. 51-301.)

2,561,353. Lithographic printing plate. James Finno, Brooklyn, N. Y. Filed Feb. 3, 1947. 7 claims. (Cl. 101-149.2.) The base is an unsized sheet of uncalendered amyloid parchment paper.

2,561,391. Frozen food container. Donald G. Magill and Richard P. Bigger, assignors to American Can Co., New York, N. Y. Filed Feb. 12, 1946. 1 claim. (Cl. 229-5.5.) A semi-rigid frozen food container consists of a tubular fibrous body and metal end member.

2,561,485. Boxmaking machine. George S. Sillars, assignor to Hoague-Sprague Corp., Lynn, Mass. Filed May 6, 1948. 5 claims. (Cl. 93-49.)

2,561,488. Handbag. Percy Barker, assignor to Plastic Specialty Co., San Francisco, Calif. Filed March 26, 1949. 1 claim. (Cl. 229-46.)

2,561,504. Container. Joseph P. Dwyer, assignor to Cluett, Peabody & Co., Inc., Troy, N. Y. Filed April 25, 1947. 7 claims (Cl. 206-45.14.) A cardboard container for neckties.

2,561,568. Pour container. Marian C. Falk, Boise, Idaho. Filed Feb. 15, 1949. 2 claims. (Cl. 229-17.) A waxed paper container for milk, cream, cereals, and the like.

2,561,617. Process for production of fibers. Gustave D. Fortman, assignor to Flortex Fiber Corp., Tampa, Fla. Filed March 19, 1946. 4 claims. (Cl. 19-8.) A method for liberating fibers from yucca and like plants.

2,561,731. Temperature-preserving article container. Paul N. Fenske, Morton, Minn. Filed Feb. 6, 1948. 4 claims. (Cl. 229-14.) Container for packing articles to preserve initial temperature conditions.

2,561,776. Automatic carton erecting machine. Leon Benoit and Raymond Vahle, assignors to Robert Gair Co., Inc., New York, N. Y. Filed Dec. 5, 1945. 24 claims. (Cl. 93-37.) A machine for assembly and erection of a carton from a pair of complementary slitted blanks.

2,561,781. Method for making reinforced laminated material. Donald S. Bruce, assignor to Gummed Products Co., Troy, Ohio. Filed April 21, 1950. 10 claims. (Cl. 154-93.) A laminated gummed paper tape is reinforced by threads or cords.

2,561,976. Decalcomania paper. Lewis Davis, assignor to McLaurin-Jones Co., Brookfield, Mass. Filed Oct. 9, 1947. 3 claims. (Cl. 117-3.6.) An adhesive is proposed for a decalcomania.

2,561,979. Shipping container cover lock. Walter C. George, assignor to Gaylord Container Corp., St. Louis, Mo. Filed May 11, 1950. 9 claims. (Cl. 229-47.) A shipping container for fruits and vegetables incorporates locking wires in the lid of the box.

2,561,999. Method of making linings for jordan engines. Harold D. Stuck, assignor to John W. Bolton & Sons, Inc., Lawrence, Mass. Filed March 4, 1946. 2 claims. (Cl. 92-27.) A moldable plastic material is used as a separator between the knives of a jordan shell or the bars of a plug.

2,562,026. Automatic web guiding apparatus. Irwin L. Fife, Oklahoma City, Okla. Filed June 7, 1946. 6 claims. (Cl. 242-76.) A web-guiding apparatus is designed to compensate for any lateral deviation of a paper or like web by controlling its path of travel through accurate alignment of the edges.

July 31, 1951

2,562,233. Collapsible cellular carton. Kenneth T. Buttery, assignor to Sutherland Paper Co., Kalamazoo, Mich. Filed Nov. 1, 1945. 5 claims. (Cl. 229-28.) A cellular egg carton.

2,562,261. Container. William La Vern Collins, assignor to Morris Paper Mills, Chicago, Ill. Filed Feb. 12, 1949. 5 claims. (Cl. 229-16.) A paperboard folder-type container and closure.

2,562,389. Bag and method. Thomas E. Piazze, assignor to Shellmar Products Corp., Mount Vernon, Ohio. Filed Nov. 3, 1945. 9 claims. (Cl. 229-62.)

2,562,454. Paper strap forming machine. Frank A. Grant, assignor to Paper Strap, Inc., Portland, Ore. Filed July 19, 1947. 11 claims. (Cl. 270-94.) A method of threading a paper web through the machine.

2,562,456. Tea bag. Benedict B. Gunnar, Stamford, Conn. Filed July 9, 1949. 2 claims. (Cl. 99-77.1.)

2,562,506. Batch mixing apparatus. Adolph H. Peterson and Roy K. Castleman, assignors to Fibreboard Products, Inc., San Francisco, Calif. Filed Jan. 31, 1949. 7 claims. (Cl. 198-103.)

2,562,558. Starch preparation soluble in cold water and process of making the same. Jan Lolkema and Willem A. van der Meer, assignors to Naamlooze Vennootschap W. A. Scholten's Chemische Fabrieken, Groningen, Netherlands. Filed Nov. 1, 1946. 3 claims. (Cl. 260-17.3.)

2,562,570. Paper container. Gilbert F. O'Brien, New York, N. Y. Filed Feb. 10, 1948. 10 claims. (Cl. 229-23.) A two-piece paper container for fresh fruits and vegetables.

2,562,579. Method of applying end closures to containers. William A. Ringler, assignor to The Gardner Board and Carton Co., Middletown, Ohio. Filed Aug. 29, 1944. 2 claims. (Cl.

93-55.1.) A liquidtight paperboard container adapted for hermetic sealing.

2,562,641. Method of forming laminated articles. Seymour G. Saunders, assignor to Chrysler Corp., Highland Park, Mich. Filed May 3, 1946. 3 claims. (Cl. 154-140.)

2,562,655. Means for packaging articles for handling. Albert P. D. Belanger, assignor to Alton Box Board Co., Alton, Ill. Filed Sept. 13, 1947. 10 claims. (Cl. 229-14.) A package for light bulbs.

2,562,676. Laminated dry stencil. John L. Morton and Harry O. George, assignors to International Business Machines Corp., New York, N. Y. Filed Jan. 6, 1948. 1 claim. (Cl. 101-128.2.) A laminated dry stencil for use in duplicating or check-writing machines.

2,562,711. Method of producing heat and sound insulation. Albert E. Gessler, William F. Grupe, Clifford J. Rolle, and Francis J. Tuttle, assignors to Interchemical Corp., New York, N. Y. Filed Feb. 25, 1948. 2 claims. (Cl. 154-110.) A plastic foil is laminated to a relatively thick backing of Celotex or Fiberlite board.

2,562,814. Sulfonate lubricating grease. Rosemary O'Halloran, assignor to Standard Oil Development Co., Linden, N. J. Filed March 5, 1949. 15 claims. (Cl. 252-33.3.) Tall oil is used.

2,562,859. Plasterboard. Thomas P. Camp, assignor to United States Gypsum Co., Chicago, Ill. Filed Jan. 10, 1947. 4 claims. (Cl. 154-45.9.) A gypsum-core, paper-covered plasterboard is coated on one side with a 5% solution of potassium carbonate which decreases the waterproofing effect of the rosin size.

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2,562,898. Lignin resins and process of making same. Raymond N. Evans and Angelo P. Ingrassia, assignors to Masonite Corp., Laurel, Miss. Filed May 24, 1946. 6 claims. (Cl. 260–17.3.) The resin is prepared from lignin, melamine, 37% formaldehyde, and furfuryl alcohol; the resins are suitable for laminating paper, board, and plywood.

2,563,065. Bottle carrier. Charles S. Price, assignor to Reynolds Metals Co., Richmond, Va. Filed June 22, 1946. 1 claim. (Cl. 229-52.) A foil-covered paperboard bottle carrier with bottle-gripping flaps.

2,563,111. Flexible veneer and process for making same. Herbert Hampson and Paul Quinn, assignors to General Coated Products, Inc., Paterson, N. J. Filed Sept. 2, 1950. 9 claims. (Cl. 154-121.) A thin overlay sheet is impregnated with 50–75% of a heat-set resin (melamine-aldehyde and diallyl phthalate) and laminated to a relatively thick backing sheet of saturating paper impregnated with 20–30% of a cured rubbery polymer.

2,563,117. Means for increasing the opacity of sheets or webs of paper or the like. Albert B. Hurley, assignor to North American Paper Process Co., Inc., Dover, Del. Filed Nov. 5, 1947. 7 claims. (Cl. 101-248.) A control device serves to maintain coated grids or screens on opposite sides of a paper web in such relative positions as to increase the opacity of the treated web.

2,563,132. Packaging member. Richard E. Paige, New York, N. Y. Filed July 3, 1947. 7 claims. (Cl. 229-28.) A scalloped corrugated board separator.

2,563,145. Folding tray. Elmer L. Winkler, assignor to Mott Carton and Paper Co., St. Louis, Mo. Filed Dec. 29, 1948. 5 claims. (Cl. 229-34.) A corner-locking open tray for the packaging of baked goods, fruits, vegetables, and the like.

2,563,249. Paper machinery. Bernard J. Koziol, assignor to The Black-Clawson Co., Hamilton, Ohio. Filed Oct. 28, 1948. 14 claims. (Cl. 92–29.) A vibrating screen; the stock which is being screened is subjected to centrifugal and pumping action.

2,563,316. Article of manufacture and method. Oscar J. De Sylva, assignor to Shellmar Products Corp., Mount Vernon, Ohio. Filed Nov. 9, 1945. 4 claims. (Cl. 206-46.) The walls of a heat-sealable bag comprise inner linings of Saran sheeting laminated to outer sheets of paper or cloth.

2,563,352. Insulated cup. Malcolm W. Morse, Wellesley Hills, Mass. Filed April 5, 1946. 3 claims. (Cl. 229-14.) A frusto-conical paper food container with circumferential ribs which form an insulating chamber when two containers are nested.

2,563,596. Folding box machine. Walter P. Fergnani, assignor to Post Machinery Co., Beverly, Mass. Filed June 5, 1946. 5 claims. (Cl. 93-49.)

2,563,619. Paperboard carton capable of holding liquids. William A. Ringler, assignor to The Gardner Board and Carton Co., Middletown, Ohio. Filed June 13, 1945. 1 claim. (Cl. 229-37.) A paperboard container adapted for hermetic sealing is rendered liquidtight without subjection of the end closures to a dipping operation.

2,563,620. Automatically partitioned carrier device. William A. Ringler, assignor to The Gardner Board and Carton Co., Middletown, Ohio. Filed Aug. 14, 1945. 2 claims. (Cl. 229-28.) A knockdown bottle carrier incorporates integral partition members which are automatically erected when the carrier is set up.

2,563,632. Apparatus for forming rounded bottoms on conically shaped cups. Walter E. Amberg, assignor to Lily-Tulip Cup Corp., Chicago, Ill. Filed Feb. 11, 1948. 1 claim. (Cl. 93-36.2.) A mold die is adapted for the rounding of the bottom of a conical paper cup.

2,563,633. Method of forming rounded bottom conical paper cups. Walter E. Amberg, assignor to Lily-Tulip Cup Corp., Chicago, Ill. Filed May 25, 1949. 3 claims. (Cl. 93-36.2.) Method of forming a spoon serviceable bottom in a conical paper cup.

2,563,660. Constant tension drive for web reels. Jacques A. L. Rebut and Pierre Cherigié, assignors to La Cellophane, Paris, France. Filed Jan. 4, 1950. 4 claims. (Cl. 242-75.) A winder for webs of regenerated cellulose.

2,563,692. Yankee drier. Harry M. Ostertag and John H. Masshard, assignors to Scott Paper Co., Chester, Pa. Filed Sept. 21, 1944. 9 claims. (Cl. 257-95.) A Yankee drier has a double shell and is capable of safe operation at high steam pressures.

2,563,790. Papermaking apparatus. Allen A. Lowe, assignor to The Sandy Hill Iron & Brass Works, Hudson Falls, N. Y. Filed April 14, 1948. 1 claims. (Cl. 92-44.) A flowbox includes a number of separate sections which provide an inlet and several interconnected discharge orifices.

August 14, 1951

2,563,833. Manually operated hydraulic clamping means for testing machines. Raymond E. Getchell, assignor to B. F. Perkins & Son, Inc., Holyoke, Mass. Filed Jan. 24, 1949. 5 claims. (Cl. 73-102.) A bursting strength tester includes means for the application of a predetermined clamping pressure to a paper specimen and for the release of such pressure.

2,563,856. Defoaming agent for pulp and paper stock. Earl P. McGinn, assignor to Nopco Chemical Co., Harrison, N. J. Filed Oct. 12, 1945. 5 claims. (Cl. 252-358.) The agent is an aqueous emulsion containing 20% scale wax, 2% candelilla wax, 15% glyceryl monostearate, and the sodium salt of castor fatty acids.

2,563,857. Defoaming agent for pulp and paper stock. Earl P. McGinn, assignor to Nopco Chemical Co., Harrison, N. J. Filed Oct. 12, 1945. 5 claims. (Cl. 252-358.) The composition is similar to the above but contains potassium stearate.

2,563,897. Sizing cellulosic fibers with cationic melamine resin and hydrophobic material. Lucius H. Wilson, Chester G. Landes, and Charles S. Maxwell, assignors to American Cyanamid Co., New York, N. Y. Filed July 13, 1945. 10 claims. (Cl. 92-21.) A method is adapted for the production of a felted fibrous cellulosic material which contains 50–100% by weight of a resinous impregnating agent (e.g., polystyrene).

2,563,945. Collapsible sanitary lining for washbowls. Maxwell E. Lang, New York, N. Y. Filed April 9, 1946. 1 claim. (Cl. 229-1.5.) A die-formed liner of glassine or cellophane.

2,563,947. Machine for manufacturing and assembling filler partitions. Jewell G. Locke, assignor to Anchor Hocking Glass Corp., Lancaster, Ohio. Filed Aug. 28, 1946. 6 claims. (Cl. 164-61.) A machine for manufacture and assembly of corrugated board partitions into filler units for containers.

2,564,028. Wood pulp digestion. Arthur N. Parrett, assignor to Rayonier, Inc., Shelton, Wash. Filed Jan. 17, 1946. 3 claims. (Cl. 92-11.) A method of pulping with ammonia-base liquor and the recovery of the spent liquor.

2,564,099. Carton end closure structure. Robert M. Dunning, assignor to Waldorf Paper Products Co., St. Paul, Minn. Filed May 3, 1947. 1 claim. (Cl. 229-17.) A method of sealing the end flaps of cartons.

2,564,252. Box cap. Archie L. Dickson, Jr., Gulfport, Miss. Filed June 14, 1949. 2 claims. (Cl. 229-7.) Removable box cap for an open-topped box.

2,564,276. Preserving composition. Gordon J. Pritchard, London, England. Filed Aug. 24, 1948. 7 claims. (Cl. 167-38.6.) A rotproofing material contains the bisphenylmercuric salt of bis(2-naphthalenesulphonic acid).

2,564,430. Slime control. Athey G. Gillaspie, assignor to The Hamilton Laboratories, Inc., Asheville, N. C. Filed March 30, 1946. 4 claims. (Cl. 92-21.) The agent is the sodium salt of mercurated benzenesulphonic acid.

2,564,449. Stabilized paperboard carrier. William A. Ringler, assignor to The Gardner Board and Carton Co., Middletown, Ohio. Filed July 12, 1949. 11 claims. (Cl. 229-28.) A paperboard bottle carrier.

2,564,452. Method for recovering sulfur dioxide in liquid form. Väinö H. Somer, assignor of one half to Aktiebolaget Kaukas Fabrik, Lauritsala, Finland. Filed Oct. 26, 1946. 3 claims. (Cl. 62-175.5.) A method of recovering sulphur dioxide from relief gases.

2,564,462. Valved bag and its manufacture. Charles V. Brady and August F. Ottinger, assignors to Bemis Bro. Bag Co., St. Louis, Mo. Filed Jan. 17, 1949. 5 claims. (Cl. 150-9.) A fabric valve bag incorporates a stiff paper reinforcing tongue.

2,564,594. Roll wrapping machine. Harold E. Clarke, assignor to Canadian International Paper Co., Montreal, Canada. Filed Sept. 13, 1949. 2 claims. (Cl. 93-2.) A machine for wrapping rolls of newsprint.

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2,564,693. Diaphragm construction. Lloyd Hornbostel, assignor to Beloit Iron Works, Beloit, Wis. Filed Aug. 20, 1947. 4 claims. (Cl. 137-157.) A flexible rubber diaphragm for use in fluid-actuated diaphragm units for the loading of press rolls.

2,564,845. Disposable bag for vacuum cleaners. George W. Holt, Jr., assignor to Marathon Corp, Rothschild, Wis. Filed March 7, 1946. 2 claims. (Cl. 183-51.)

2,564,901. Solenoid controlled taping machine. Charles Hess, assignor to S&S Corrugated Paper Machinery Co., Inc., Brooklyn, N. Y. Filed Nov. 20, 1947. 10 claims. (Cl. 216-22.) Electromechanical means for applying the tape to a box and cutting it off at the proper point as the folded box moves through the machine.

2,564,948. Lined multiple-blank master shipping carton. Horace W. Beck, Jr., and Clyde F. Gibbons, assignors to Gaylord Container Corp., St. Louis, Mo. Filed Jan. 21, 1949. 4 claims. (Cl. 229-23.) A heavy-duty master carton.

2,565,026. Moisture-vapor-proof pouch. John W. Hutt, assignor to Canada Foils Ltd., Toronto, Canada. Filed Nov. 4, 1946. 2 claims. (Cl. 229-53.) A heat-sealed tobacco pouch of bellows-type construction.

2,565,053. Telescoping box or carton having interlocking wall elements. Richard C. Stenger, assignor to Sutherland Paper Co., Kalamazoo, Mich. Filed July 7, 1949. 7 claims. (Cl. 229-35.) The parts of the container are so arranged as to permit engagement of the cover with the body without displacement of the interlocking parts of the cover.

2,565,146. Spacing device for shipping cartons and the like. Nathan Okon, Bronx, N. Y. Filed April 6, 1949. 2 claims. (Cl. 229-42.) A separator for a shipping carton.

2,565,152. Process of impregnating a fibrous sheet with a phenolic resin. Joseph J. Wachter and Cyril J. Straka, assignors to Westinghouse Electric Corp., East Pittsburgh, Pa. Filed Oct. 30, 1946. 5 claims. (Cl. 117-65.) A paper sheet is impregnated with a thermosetting phenol-aldehyde resin and formed into a laminate; the varnish contains a base (inorganic or organic) as a catalyst.

2,565,162. Paper feed mechanism for cupmaking machines. Paul E. Wixon, Reistertown, and Clarence E. Chapman, Baltimore, Md., assignor to Joseph Shapiro. Filed May 23, 1949. 5 claims. (Cl. 271-2.5.)

2,565,182. Carton construction. Karl E. Maxon, Los Angeles, Calif. Filed Oct. 24, 1947. 14 claims. (Cl. 229-17.) A carton has an integral pouring spout which incorporates several radiating V-shaped troughs.

2,565,188. Polygonal box. Charles D. Welshenbach, assignor to The Hinde & Dauch Paper Co., Sandusky, Ohio. Filed Nov. 4, 1948. 2 claims. (Cl. 229-16.) A box of eight or more sides can be folded flat for shipment or storage.

2,565,251. Plywood panel. Homer E. Malmstrom, assignor to Paper Patents Co., Neenah, Wis. Filed April 30, 1948. 4 claims. (Cl. 154-45.9.) A Douglas-fir plywood panel has a surface at least one sheet of which contains 35–60% of phenol-, melamine-, or urea-formaldehyde resin.

2,565,258. Apparatus for making paper and like bags. John Nicholas, assignor to E. S. & A. Robinson, Ltd., Bristol, England. Filed Aug. 27, 1947. 6 claims. (Cl. 93-22.)

2,565,260. Method of and apparatus for coating paper. James J. O'Connor, Russell H. Savage, and Hellmuth C. Schwalbe, assignors to The Mead Corp, Chillicothe, Ohio. Filed April 28, 1947. 14 claims. (Cl. 117-111.) A roll-coating machine is designed for use in the manufacture of a mineral-finished book paper.

2,565,288. Unitary reinforced folding box. Robert B. Worford, assignor to The Gardner Board and Carton Co., Middletown, Ohio. Filed Jan. 10, 1948. 9 claims. (Cl. 229-33.) The box has a reinforced, double-thickness rear wall.

2,565,340. Insulation board. Harvey R. Anderson, assignor to Keasbey and Mattison Co., Ambler, Pa. Filed June 8, 1949. 8 claims. (Cl. 106-99.) The board is formed of asbestos fiber, fine silica, and hydrated lime.

2,565,371. Apparatus for testing paperboard with controlled pressure. Robert F. Hollis, assignor to Alton Box Board Co., Alton, Ill. Filed July 31, 1946. 2 claims. (Cl. 73-102.) The pressure which is applied to the test specimen in a Mullen tester can be predetermined and standardized.

2,565,444. Machine for forming, packing, and sealing containers. Harry F. Waters, New York, N. Y. Filed July 9, 1949. 15 claims. (Cl. 93-3.) Means for manufacturing a number of side-by-side continuous rows of joined envelope containers from one or more continuous paper webs.

2,565,449. Bottle carrier. Clyde L. Emrick, assignor to Morris Paper Mills, Chicago, Ill. Filed Jan. 8, 1948. 3 claims. (Cl. 229-52.) A bottle carrier has a multi-ply, reinforced handle.

August 28, 1951

2,565,484. Fractionation of tall oil. Lawrence H. Dunlap and Carl F. Sievert, assignors to Armstrong Cork Co., Lancaster, Pa. Filed March 15, 1949. 7 claims. (Cl. 260-97.6.) Tall oil is oxidized, dissolved in furfural, and extracted with petroleum ether; the oxidized tall oil fraction is free of saturated fatty acids.

2,565,520. Calender machine. Charles P. Putnam, assignor to New York and Pennsylvania Co., Inc., New York, N. Y. Filed Nov. 3, 1945. 13 claims. (Cl. 92-71.) A tandem supercalender incorporates swingably mounted rolls which can be replaced without stopping the machine.

2,565,622. Valve bag. Howard H. Orr, Cleveland, Ohio. Filed Oct. 6, 1945. 4 claims. (Cl. 229-62.5.) A bag for cement, plaster, or the like.

2,565,641. Apparatus for making slitted and expanded sheet material. Adam Ziska, assignor to Research Products Corp., Madison, Wis. Filed Aug. 21, 1946. 13 claims. (Cl. 164-6.5.)

2,565,682. One-piece reinforced carton. Reynolds Guyer, assignor to Waldorf Paper Products Co., St. Paul, Minn. Filed June 19, 1946. 8 claims. (Cl. 229-16.) A one-piece reinforced carton has double-thickness opposed side walls.

2,565,683. Bottle carrier. Reynolds Guyer, assignor to Waldorf Paper Products Co., St. Paul, Minn. Filed Aug. 5, 1948. 11 claims. (Cl. 224-48.) A bottle carrier consists of a U-shaped tray and a U-shaped carrying handle.

2,565,754. Bag of open-mesh material and paper. Charles V. Brady and August F. Ottinger, assignors to Bemis Bro. Bag Co., St. Louis, Mo. Filed Oct. 9, 1948. 4 claims. (Cl. 229-53.) A ventilated open-mesh bag incorporates a relatively large area of kraft or creped paper.

2,565,810. Bottle carrier, Reynolds Guyer, assignor to Waldorf Paper Products Co., St. Paul. Minn. Filed Aug. 5, 1948. 7 claims. (Cl. 224-48.) The carrier consists of a U-shaped tray and a carrying handle.

2,565,938. Lubricant metal-rolling composition. Robert C. Williams, assignor to The Ironsides Co., Columbus, Ohio. Filed May 11, 1949. 6 claims. (Cl. 252-49.5.) The total free acids content of 6–9% consists of four parts of tall oil and 96% of a tallow.

2,565,944. Formation of articulated containers. Robert M. Bergstein, Cincinnati, Ohio. Filed Jan. 6, 1947. 5 claims. (Cl. 93-36.) Articulated cartons are formed from nonscorable sheets.

2,565,949. Process and apparatus for molding sheet material. Walter B. Clifford and Richard R. Walton, Boston, Mass. Filed April 12, 1947. 10 claims. (Cl. 113-44.) Method of molding board in a wet or dry condition into three-dimensional shapes.

2,566,016. Container for disposable tissues. Clarence W. Cochran, Belmont, Mass. Filed June 7, 1947. 2 claims. (Cl. 229-15.)

2,566,092. Processes for making paper having insecticidal properties and products resulting thereform. Paul Mayfield, assignor to Hercules Powder Co., Wilmington, Del. Filed Dec. 7, 1946. 7 claims. (Cl. 117-154.) The paper contains 1% or more of a polychlorocamphene with 60–72% chlorine.

2,566,130. Manufacture of glassine paper. Karl R. Karlson and Clifford E. Peterson, assignors to Riegel Paper Corp., New York, N. Y. Filed June 10, 1944. 5 claims. (Cl. 92-20.) The furnish contains a hydrated long-fiber sulphite pulp and a bleached neutral sulphite semichemical pulp.

2,566,244. Ethylene/vinyl alcohol/acrylic acid copolymers, their ammonium salts, and paper coated therewith. Paul S. Pinkney, assignor to E. I. du Pont de Nemours & Co., Wilmington, Del. Filed Nov. 10, 1949. 4 claims. (Cl. 117-155.) The polymer, containing 25–60% ethylene, 10–30% vinyl alcohol, and 25–60% acrylic acid as the ammonium salt, is used as a binding for clay and other paper-coating pigments.

September 4, 1951

2,566,439. Papermaking machine rectifier roll. Edward D. Beachler, assignor to Beloit Iron Works, Beloit, Wis. Filed June 27, 1946. 4 claims. (Cl. 29-121.) The structure of a rectifier roll is described.

2,566,449. Rectifier roll. Lloyd Hornbostel, assignor to Beloit Iron Works, Beloit, Wis. Filed June 26, 1946. 9 claims. (Cl. 92-44.) The rectifier roll is a perforated tube and a number of spaced parallel baffles.

2,566,450. Flow evener. Lloyd Hornbostel, assignor to Beloit Iron Works, Beloit, Wis. Filed June 26, 1946. 5 claims. (Cl. 92-44.) A flow evener for a stock inlet is equipped with a rectifier roll which converts crossflow velocity into the desired exit velocity.

2,566,529. Coating of paper. John A. Montgomerie, assignor to Chemical Manufacturing Co., Dublin, Erie. Filed Feb. 14, 1948. 11 claims. (Cl. 106-144.) A paper coating composition comprises a dispersion of a vegetable resin (rosin) in an aqueous casein solution.

2,566,869. Rotary refiner. Edmund P. Arpin, Jr., Neenah, Wis. Filed Feb. 25, 1948. 9 claims. (Cl. 92-26.) A refiner consists of a number of rotor stones which are resiliently secured in a backing plate which is pivotally mounted in a housing attached to the rotating shaft of the refiner.

2,566,938. Seating means for wood chipper bed knives. Charles A. Johnson, Berlin, N. H. Filed May 13, 1948. 5 claims. (Cl. 241-92.) The chipper has a knife base in which the knife is self-seating and firmly held in proper spaced relation to the rotating cutting knives.

2,567,010. Fungistatic wrapper. Gerald H. Coleman and Paul A. Wolf, assignors to The Dow Chemical Co., Midland, Mich. Filed Jan. 13, 1947. 3 claims. (Cl. 167-33.) The paper contains at least 0.3% of dehydroacetic acid.

2,567,017. Paper receptacle. Dwight E. Gillespie, assignor to Owens-Illinois Glass Co., Toledo, Ohio. Filed Nov. 19, 1946. 3 claims. (Cl. 229-17.) A paper container with a hinged top panel which carries a sanitary pouring spout.

2,567,067. Pressure sensitive decalcomania and method of making the same. Alfred F. Grupp, Harry C. Rathke, Elwood S. Talan, and Elmore Watts, assignors to The Meyercord Co., Chicago, Ill. Filed Nov. 29, 1947. 16 claims. (Cl. 117-3.6.)

2,567,097. Multiple impregnation of papermaker's felt. Orion W. Berglund, assignor to The Orr Felt & Blanket Co., Piqua, Ohio. Filed Dec. 23, 1946. 5 claims. (Cl. 117-76.) The felt is impregnated with 5–15% by weight of urea- or phenol-formaldehyde resin and a superimposed layer of synthetic rubber.

2,567,136. Agglomerates of fuel and manufacture process. Antoine Vloeberghs, Antwerp, Belgium. Filed Oct. 1, 1946. 6 claims. (Cl. 44-21.) A fuel agglomerate contains up to 6% spent sulphite liquor and up to 3% of a phenol-formaldehyde resin.

2,567,151. Diaphragm unit. Lloyd Hornbostel, assignor to Beloit Iron Works, Beloit, Wis. Filed July 30, 1945. 5 claims. (Cl. 137-157.) A diaphragm unit is adapted for use in a fluid pressure-controlled roll assembly in a papermaking machine.

September 11, 1951

2,567,186. Inverse method of forming particulate coated sheets. Bert S. Cross and George P. Netherly, assignors to Minnesota Mining & Manufacturing Co., St. Paul, Minn. Filed June 23, 1948. 9 claims. (Cl. 154-95.) A laminated sheet consists of a backing sheet, a binder layer, and a layer of particles bonded therein.

2,567,219. Plural intermeshing feed or press screws. Frank G. Lesniak, assignor to Masonite Corp., Laurel, Miss. Filed Feb. 12, 1945. 5 claims. (Cl. 100-48.) An intermeshing screw construction is useful in the expression of liquid from fiber stock or other vegetable material.

2,567,267. Method of packaging. Edward D. Andrews, assignor to The Quaker Oats Co., Chicago, Ill. Filed May 20, 1947. 6 claims. (Cl. 93-3.) A cereal package consists of a cardboard sleeve and an outer wrapper of cellophane, rubber hydrochloride, or the like.

2,567,558. Asbestos sheet material and method of manufacture. Harold W. Greider and Marion F. Smith, assignors to The Philip Carey Manufacturing Co., Lockland, Ohio. Filed Dec. 29, 1944. 15 claims. (Cl. 117-126.)

2,567,559. Asbestos sheet material and method of manufacture. Harold W. Greider and Marion F. Smith, assignors to The Philip Carey Manufacturing Co., Lockland, Ohio. Filed Dec. 29, 1944. 20 claims. (Cl. 117-126.)

2,567,706. Moisture-destructible container. John A. Hannum and Joseph N. Epel, assignors to Hefco Laboratories, Detroit, Mich. Filed Jan. 9, 1946. 1 claim. (Cl. 229-3.5.) A paper container is adapted to retain moisture around the roots of young plants subsequent to their placement in the ground.

2,567,786. Telescopic shipping carton. Leon J. Rosenberg, assignor to Gaylord Container Corp., St. Louis, Mo. Filed Oct. 17, 1947. 2 claims. (Cl. 229-23.) A relatively tall, heavy-duty, corrugated shipping container.

2,567,832. Packing and storage container. Samuel Vadner, Narberth, Pa. Filed Jan. 31, 1949. 2 claims. (Cl. 229-23.) A packing case for bottled beer and the like.

2,567,885. Continuously operating pulper. Dwight E. Jones, assignor to E. D. Jones & Sons Co., Pittsfield, Mass. Filed Aug. 10, 1949. 2 claims. (Cl. 92-26.) A pulper for waste paper or the like.

September 18, 1951

2,568,033. Horticultural composition comprising a polymeric organic polysulfide and a petroleum oil fraction. William D. Stewart, assignor to The B. F. Goodrich Co., New York, N. Y. Filed April 11, 1947. 3 claims. (Cl. 167-22.) The components are dispersed in an aqueous solution of a lignosulphonate.

2,568,034. Horticultural composition comprising polyethylene polysulfide and sulfur or lime-sulfur. William D. Stewart, assignor to The B. F. Goodrich Co., New York, N. Y. Filed April 11, 1947. 3 claims. (Cl. 167-20.) The components are dispersed in an aqueous solution of a lignosulphonate.

2,568,035. Horticultural composition comprising DDT and polyethylene polysulfide. William D. Stewart, assignor to The B. F. Goodrich Co., New York, N. Y. Filed April 11, 1947. 4 claims. (Cl. 167-22.) The components are dispersed in an aqueous solution of a lignosulphonate.

2,568,170. One-piece lined box. William A. Ringler, assignor to The Gardner Board and Carton Co., Middletown, Ohio. Filed May 18, 1946. 12 claims. (Cl. 229-14.) A glassine-, parchment-, or cellophane-lined frozen food container.

2,568,199. Method and apparatus for testing papers and the like. Noël Martinet, assignor to Société des Papiers et Cartons Couchés "Lux," Fures, France. Filed Feb. 17, 1948. 8 claims. (Cl. 175-183.) A method and apparatus for the determination of the ink permeability of paper and board by the use of electrodes.

2,568,204. Container. Harry C. Reeser, assignor to The Patent and Licensing Corp., New York, N. Y. Filed Jan. 19, 1949. 4 claims. (Cl. 229-34.) A shipping container with corner braces.

2,568,239. Art of treating black liquors. Harold E. Lonngren, New York, N. Y. Filed March 29, 1949. 2 claims. (Cl. 202-14.) A method of distillation and combustion.

2,568,288. Method of coating paper. William J. Montgomery, assignor to The Champion Paper and Fibre Co., Hamilton, Ohio. Filed April 30, 1948. 23 claims. (Cl. 117-64.) A method for the continuous production of a uniformly high-quality, cast-surfaced coated paper.

2,568,349. Corrugated board and method of making same. Robert C. McKee, assignor to The Institute of Paper Chemistry, Appleton, Wis. Filed June 22, 1950. 6 claims. (Cl. 154-33.05.) The corrugating medium of a container board is impregnated with sulphur.

2,568,382. Method and apparatus for making containers. Charles W. Buckley and Edgar P. Bailey, assignors to Wright Machinery Co., Durham, N. C. Filed June 14, 1946. 15 claims. (Cl. 93-51.) Food containers are made of a laminate of metal foil and paper.

2,568,420. Filter apparatus. William R. Thomson, Ottawa, Ontario, Canada. Filed March 6, 1947. 3 claims. (Cl. 210-197.) A pulp thickener is similar in construction to a horizontal-type filter; a rotary filter is operated in conjunction with the horizontal unit.

2,568,436. Bottle carrier. Louis Faria, assignor to Reynolds Metals Co., Richmond, Va. Filed Feb. 3, 1948. 1 claim. (Cl. 224-45.)

2,568,463. Method of adhering metal foil to nonmetallic carrying webs. Richard S. Reynolds, assignor to Reynolds Metals Co., Richmond, Va. Filed Oct. 23, 1946. 9 claims. (Cl. 154-117). A method of forming a laminate of a metal foil and paper.

2,568,554. Hydraulic bark remover having certain nozzles controlled by log-interrupted light beam. Gordon F. McClay, assignor to Ingersoll-Rand Co., New York, N. Y. Filed Jan. 26, 1949. 8 claims. (Cl. 144-208.) A hydraulic barker includes means for maintaining the lengths of the hydraulic jets substantially constant, regardless of the diameter of the log.

2,568,629. Flap gumming and folding mechanism for envelope machines. Vincent E. Heywood, assignor to United States Envelope Co., Springfield, Mass. Filed July 13, 1948. 3 claims. (Cl. 93-62.)

2,568,664. Method of producing paper drum containers. Arthur L. Scott, Columbus, Ohio. Filed Oct. 16, 1947. 2 claims. (Cl. 93-36.8.) A cylindrical container with integral side and end walls are formed from several convolutions of a continuous paper strip.

September 25, 1951

2,568,697. Paper closure member for paper containers. Walter E. Amberg, assignor to Lily-Tulip Cup Corp., Chicago, Ill. Filed Sept. 24, 1948. 2 claims. (Cl. 229-43.) A closure member for a cylindrical container incorporates a side flange portion which is designed to be snapped into an internal groove in the wall of the container.

2,568,698. Apparatus for forming paper closure members for paper containers. Walter E. Amberg, assignor to Lily-Tulip Cup Corp., Chicago, Ill. Filed Oct. 12, 1949. 2 claims. (Cl. 93-36.)

2,568,725. Receptacle. Harry J. Fey, assignor to James R. Kearney Corp., St. Louis, Mo. Filed Jan. 24, 1949. 4 claims. (Cl. 229-17.) A display carton for small articles.

2,568,769. Material for packing tubes and the like. Ernest L. Shephard, assignor to The Canal National Bank of Portland and William B. Nulty, Portland, Me., as trustees. Filed June 11, 1945. 4 claims. (Cl. 206-65.) A molded pulp packing material.

2,568,786. Envelope. Marion L. Boling, assignor to Ona J.

Boling, Seattle, Wash. Filed Jan. 31, 1949. 1 claim. (Cl. 229-73.) A dual-duty envelope.

2,568,849. Vapor barrier paper and the manufacture thereof. George A. Fasold and Howard E. Callahan, assignors to The Philip Carey Manufacturing Co., Cincinnati, Ohio. Filed May 14, 1947. 10 claims. (Cl. 117-137.) A flexible paper sheet is coated on at least one side with a bitumen emulsion.

2,568,850. Vapor barrier paper and the manufacture thereof. George A. Fasold and Howard E. Callahan, assignors to The Philip Carey Manufacturing Co., Cincinnati, Ohio. Filed April 11, 1951. 8 claims. (Cl. 117-137.) This is similar to the above.

2,568,941. Portfolio. Abel O. Benson, River Falls, Wis. Filed April 15, 1949. 1 claim. (Cl. 229-72.) A portfolio designed to carry an identification card.

2,569,018. Compartment box. Kendall B. Priester, assignor to Brown & Bigelow, St. Paul, Minn. Filed April 17, 1947. 2 claims. (Cl. 229-27.) A carton for two decks of playing cards.

2,569,035. Extended length fiberboard container for extruded metal shapes, rugs, and the like. Jack R. Belsinger, assignor to Belsinger, Inc., Atlanta, Ga. Filed July 12, 1948. 1 claim. (Cl. 229-6.)

2,569,134. Roofing material. Harold B. Reed, assignor to H. B. Reed and Co., Hammond, Ind. Filed Oct. 8, 1946. 3 claims. (Cl. 117-32.) The granular material is the quenched ash from wet-bottom furnaces.

2,569,169. Production of hot-bonded fiber felts. Clark C. Heritage, assignor to Wood Conversion Co., Cloquet, Minn. Filed Sept. 10, 1942. 2 claims. (Cl. 154-101.) The felt is formed of dry wood fiber and a heat-activatable adhesive (asphalt or rubber).

2,569,335. Automatic lock bottom carton. Lawrence H. Phillips, assignor to O. B. Andrews Co., Chattanooga, Tenn. Filed June 9, 1949. 2 claims. (Cl. 229-39.)

2,569,367. Endless metal belt and method of making the same. Donald B. Bradner, William B. Stoddard, Jr., and Philip S. Blickensderfer, assignors to The Champion Paper and Fibre Co., Hamilton, Ohio. Filed Jan. 8, 1946. 13 claims. (Cl. 74-232.) An electrolytically deposited nickel belt is adapted for cast-surfaced coated papers.

2,569,399. Fire resistant asphalt coating. Frank B. Burns and Millard S. Larrison, assignors to United States Gypsum Co., Chicago, Ill. Filed Aug. 7, 1943. 15 claims. (Cl. 106-282.) The coating composition consists of asphalt, asbestos fiber, vermiculite or coking coal, and diatomite, clay, or limestone dust.

2,569,414. Production of metal-free stripes on metal-coated sheet material. Philip Godley, 2nd, and William O. Di Pietro, assignors to National Research Corp., Cambridge, Mass. Filed May 10, 1949. 2 claims. (Cl. 219-19.) A method for the removal of bands of metallic coating from metal-coated electrical condenser paper.

UNITED STATES PATENTS ON PAPERMAKING

Fourth Quarter, 1951 — ***Compiled by CLARENCE J. WEST***

October 2, 1951

2,569,543. Masonry simulating roll siding and process of producing same. Charles Stolp, Jr., assignor to Allied Chemical & Dye Corp., New York, N. Y. Filed June 5, 1948. 5 claims. (Cl. 117-5.) A felt web impregnated with a bituminous saturant is coated with a bitumen and surfaced with a granular material; the surface is embossed with at least two different masonry-simulating patterns.

2,569,680. Flotation process for whitening clay. Thomas G. Leek, assignor to Edgar Brothers Co., Metuchen, N. J. Filed Feb. 4, 1949. 13 claims. (Cl. 23-110.) A clay slip is treated with a deflocculating agent and emulsified tall oil and is purified by flotation.

2,569,681. Egg carton. James W. Lennon, assignor to Shellmar Products Corp., Chicago, Ill. Filed Feb. 21, 1947. 5 claims. (Cl. 229-2.5.) A molded pulp carton comprises two complementary sections with different egg-receiving recesses.

2,569,708. Sealing strip for pulp and other types of screen plates. Henry W. Downs, Jr., Lennoxville, Quebec, Canada. Filed March 26, 1947. 1 claim. (Cl. 92-30.) The strip is adapted to seal the joint between the edge of a screen plate and the wall of a vat.

2,569,733. Carton for incandescent lamps. William A. Ringler, assignor to The Gardner Board and Carton Co., Middletown, Ohio. Filed Oct. 24, 1947. 2 claims. (Cl. 229-42.) The carton incorporates integral partition members and tabs which prevent the displacement of the bulbs within the carton.

2,569,785. Means for applying metal foil to paper in strip form. Percy A. Sporing, Hampton Hill, and Charles P. Johnson, Hanwell, England. Filed Jan. 16, 1948. 11 claims. (Cl. 242-56.) A method for the application of successive lengths of metal foil to a single length of paper; the product is suitable for the manufacture of capacitors and other insulating materials.

2,569,851. Leakproof and siftproof package. Robert A. Farrell, assignor to Marathon Corp., Rothschild, Wis. Filed June 21, 1949. 2 claims. (Cl. 229-5.5.) The container is sealed at its open ends with a flexible closure membrane. The closure consists of a bleached kraft paper coated with microcrystalline wax and an isobutylene polymer.

2,569,963. Dispensing container. Raymond W. Ward, Maplewood, N. J. Filed Aug. 1, 1950. 1 claim. (Cl. 229-17.) The container embodies an expansible end portion which is uncovered in the expanded form and a baffle for restricting the movements of the contents into the uncovered end portion.

2,569,964. Duplex bag and process of making same. Harry F. Waters, New York, N. Y. Filed Dec. 4, 1947. 4 claims. (Cl. 229-57.) A siftproof duplex bag with an automatically opening bottom is coated with lines of adhesive on predetermined regions of the bottom; the adhesive is fused after the formation of the bottom.

2,569,976. Means for automatically and intermittently feeding blanks of cardboard or similar sheet material. Flavius K. Daniels, assignor to Vickers-Armstrongs Ltd., London, England. Filed Sept. 20, 1947. 10 claims. (Cl. 271–51.) A machine for feeding blanks to a box-stitching machine or the like.

2,570,047. Bag bottomer. Edwin E. Burroughs, assignor to St. Regis Paper Co., New York, N. Y. Filed Sept. 11, 1948. 8 claims. (Cl. 93-22.) An apparatus for the automatic formation of the bottoms of multi-ply paper valve bags.

2,570,096. Facsimile wet electrolytic recording. Frank G. Calkin, assignor to Pierce Co., Providence, R. I. Filed Jan. 9, 1947. 1 claim. (Cl. 204-2.) The paper is impregnated with an aqueous solution of manganous sulphate, ammonium persulphate, sodium chloride, and sodium nitrate and is discolored by the passage of an electric current.

2,570,133. Bottle carrier. Michael H. Kowal, assignor to Empire Box Corp., Garfield, N. J. Filed April 20, 1946. 1 claim. (Cl. 224-48.) The weight of the bottles is effectively transmitted to the handle section of the carrier.

2,570,144. Folding box forming machine. Rollin W. Mettler, assignor to National Folding Box Co., Inc., New Haven, Conn. Filed July 13, 1949. 6 claims. (Cl. 93-53.) The machine includes a conveyor which accurately squares the blanks independently of the rate of advance of the conveyor and of the operation of the blank-feeding mechanism.

2,570,145. Folding box forming machine. Rollin W. Mettler, assignor to National Folding Box Co., Inc., New Haven, Conn. Filed July 13, 1949. 6 claims. (Cl. 93-53.) A machine is designed for setting up hinged-cover boxes.

2,570,146. Folding box forming machine. Rollin W. Mettler, assignor to National Folding Box Co., Inc., New Haven, Conn. Filed Nov. 23, 1949. 5 claims. (Cl. 93-53.) The mechanism is adapted to setting up the body and cover portions of a hinged-cover box.

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2,570,262. Photosensitive planographic plate. Doulgas A. Newman, assignor to Columbia Ribbon and Carbon Manufacturing Co., Inc., Glen Cove, N. Y. Filed Jan. 23, 1947. 13 claims. (Cl. 95-8.) The paper base is coated with ferric, cupric, or aluminum salt of carboxymethylcellulose and a photosensitive layer of dichromated albumin.

2,570,266. Container. Ronald E. J. Nordquist, assignor to American Can Co., New York, N. Y. Filed Dec. 31, 1948. 3 claims. (Cl. 229-7.) A rectangular waxed paper container for milk and other liquids has a friction-plug hinge closure and an auxiliary or overcap closure.

2,570,340. Master shipping carton. Walter C. George, assignor to Gaylord Container Corp., St. Louis, Mo. Filed Jan.

17, 1949. 1 claim. (Cl. 206-65.) A heavy-duty master carton has a tall, tubular, open-end liner and duplicate upper and lower slip covers which fit over the open ends of the liner.

2,570,460. Oxidizer for black liquor. Otto Kress, assignor to The Institute of Paper Chemistry, Appleton, Wis. Filed Oct. 19, 1948. 3 claims. (Cl. 23-283.) Black liquor passes over a series of alternately inclined shelves in a cylindrical tower.

2,570,614. Binding tape. Daniel J. Wall and George F. Reinhard, Jr., Grand Rapids, Mich., filed to Sackner Products, Inc. Filed July 26, 1946. 10 claims. (Cl. 154-53.6.) A strip of flexible metal ribbon, a light cardboard backing strip, and a facing of cellulose wadding.

2,570,697. Filtering apparatus. Sven G. Nordengren, Landskrona, Sweden. Filed Dec. 2, 1947. 4 claims. (Cl. 210-197.) A series of false-bottom trays is mounted on a continuous rubber belt; as a tray passes over a suction box, the liquid is removed through the perforated bottom of the tray.

2,570,804. Box carrier. Daryold M. Hazenfield, assignor to Crown Cork Specialty Corp., Decatur, Ill. Filed Dec. 14, 1949. 6 claims. (Cl. 229-52.) A corrugated box carrier with a separate cover retained in position by means of a depressible handle.

2,570,845. Rotary chipper-knife mounting. Peter N. Ottersland, Watertown, N. Y. Filed March 29, 1946. 7 claims. (Cl. 144-176.) The knife can be preadjusted in the knife holder or retainer to the proper position prior to the clamping of the knife and holder onto the chipper disk.

2,570,946. Carton packing construction. Russell J. Hennessey, assignor to Waldorf Paper Products Co., St. Paul, Minn. Filed Dec. 27, 1948. 9 claims. (Cl. 229-14.) A method for packaging an electric iron.

2,570,973. Shipping case. Theodore J. Nelson, Crockett, Calif. Filed Feb. 24, 1947. 2 claims. (Cl. 229-37.) A regular slotted container is designed to use a minimum of board stock.

2,570,982. Carton. Arthur Read, assignor to Henry F. Phillips, Piedmont, Calif. Filed Nov. 7, 1947. 3 claims. (Cl. 229-17.) One wall of a pouring spout is maintained in surface-to-surface wiping contact with one wall of the carton, thus preventing leakage.

2,571,073. Holder for coins and similar articles. David V. Stroop, Glenbrook, Conn. Filed June 6, 1946. 1 claim. (Cl. 229-71.) A cardboard holder has transparent windows.

2,571,075. Gasket material and method of making same. John C. Tomunak, assignor to Victor Manufacturing & Gasket Co., Chicago, Ill. Filed Aug. 23, 1947. 3 claims. (Cl. 117-155.) A highly absorbent paper is impregnated with an aqueous dispersion containing 40% solids, the main components being butadiene-acrylonitrile copolymer, clay, and sulphur.

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2,571,103. Bag sealing machine. Daniel Belcher and Harold V. Kindseth, assignors to Bemis Bro. Bag Co., Minneapolis, Minn. Filed Oct. 29, 1948. 13 claims. (Cl. 226-56.)

2,571,108. Decortication of fibrous material. Anton Burkardt, assignor to Sativa Corp., New York, N. Y. Filed July 26, 1945. 6 claims. (Cl. 19-28.) A maximum length of clean fiber is attained by regulation of the rate of feed of the crushing rolls and the rate of operation of the scutching mechanisms and assembly of interlocking scutching rotors relative to one another.

2,571,133. Carton. Bryce Haynes, Tuckahoe, N. Y., assignor to Audio Devices, Inc. Filed March 23, 1950. 11 claims. (Cl. 206-52.) A container for a hub-roll unit of magnetic sound-recording tape.

2,571,138. Infusion package with expandible bottom and method of manufacture thereof. Hans O. Irmscher, assignor to National Urn Bag Co., Inc., Long Island City, N. Y. Filed Oct. 24, 1949. 9 claims. (Cl. 99-77.1.) A tea bag is coated on one side with a preconditioned thermosetting plastic.

2,571,201. Slitting mechanism. Everett W. Clem, assignor to Rice Barton Corp., Worcester, Mass. Filed Oct. 3, 1947. 7 claims. (Cl. 164-65.) A slitting mechanism may be shifted back and forth between its operative and inoperative positions by remote control.

2,571,204. Apparatus for gluing packages. John D. Conti, assignor to American Viscose Corp. Wilmington, Del. Filed Feb. 18, 1949. 7 claims. (Cl. 91-51.) An apparatus for the application of glue to the side flaps of a traveling filled package.

2,571,219. Deaeration of paper making fibers. Judson A. De Cew, Mount Vernon, N. Y. Filed May 11, 1950. 5 claims. (Cl. 183-2.5.) The stock is sprayed into a closed tank, deaerated with a vacuum pump, and allowed to settle to the bottom of the tank.

2,571,334. Method of making resilient batts. William H. Browne, assignor to Houdaille-Hershey Corp., Detroit, Mich. Filed Aug. 30, 1946. 4 claims. (Cl. 154-101.) An air blast is used for atomizing and spraying a bonding agent onto the strands of vegetable fibers and the like.

2,571,335. Machine for making resilient batts. William H. Browne, assignor to Houdaille-Herskey Corp., Detroit, Mich. Filed Oct. 24, 1946. 13 claims. (Cl. 154-29.)

2,571,340. Packaging. Clarence M. Carson, assignor to Wingfoot Corp., Akron, Ohio. Filed April 8, 1949. 1 claim. (Cl. 99-171.) A composite wrapper for a package of cherries or other fresh fruit or vegetables consists of alternate strips of semiglassine paper coated with a butadiene-styrene copolymer and rubber hydrocloride film.

2,571,408. Egg container and method of making it. Samuel Bergstein, Cincinnati, Ohio. Filed May 22, 1948. 11 claims. (Cl. 229-28.) A cellular egg container incorporates a longitudinal supporting rib.

2,571,955. Removable blank feeding slat. Albert F. Shields, assignor to S&S Corrugated Paper Machinery Co., Inc., Brooklyn, N. Y. Field March 1, 1949. 3 claims. (Cl. 198-175.) A removable feed slat holds down the folded flaps of a box blank during the feeding of the blank through the machine.

2,571,978. Machine for preparing masking paper. John L. Watson, Welch, W. Va. Filed Oct. 9, 1947. 4 claims. (Cl. 154-31.)

2,571,986. Dry process for making composite products with pH control. Earl G. Hallonquist, assignor to Plywood Research Foundation, Tacoma, Wash. Filed Nov. 21, 1949. 8 claims. (Cl. 18-47.5.) A water-resistant composition board is formed from a dry mixture of wood particles with a thermosetting phenol-formaldehyde resin or other additive; the pH is adjusted to less than 6 and the mixture is consolidated by heat and pressure.

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2,571,993. Nitric acid-sodium hydroxide digestion of lignocellulose. Germaine M. H. Desorbay, Paris, France. Filed March 16, 1948. 4 claims. (Cl. 92-9.) Wood (birch, oak, or a conifer) is treated 3 to 48 hours with 30° Bé. nitric acid at 5 to 20°C. and the washed product is digested with 0.5–5% sodium hydroxide at room temperature.

2,572,035. Plastic tall oil rosin fraction. Wesley A. Jordan and Melvin S. Herban, assignors to General Mills, Inc., Minneapolis, Minn. Filed Aug. 14, 1948. 8 claims. (Cl. 260-97.5.) A tall oil fraction containing 69% rosin acids and 29% fatty acids is esterified with a polyhydric alcohol (glycerol or pentaerythritol) until the acid number is reduced by about 40%.

2,572,123. Self-erecting carton. Anthony G. Edtmiller, assignor to Cornell Paperboard Products Co., Chicago, Ill. Filed Sept. 20, 1947. 4 claims. (Cl. 229-41.) The container has a false bottom which is hingedly connected with a front panel along a scoreline.

2,572,159. Tuck end container. Benjamin F. Kells and Julian C. d'Esposito, assignors to Continental Corp. of America, Chicago, Ill. Filed April 11, 1947. 4 claims. (Cl. 229-45.) The container has double end walls which provide a pocket at each end into which a tuck flap on the cover can be inserted.

2,572,239. Box with overlapped end walls. Frank D. Bergstein, Wyoming, Ohio. Filed Dec. 20, 1947. 5 claims. (Cl. 229-34.) A glued paperboard box embodies a locking means for the infolded end wall flaps.

2,572,387. Container. Alden G. Rayburn, Sausalito, Calif. Filed May 21, 1946. 1 claim. (Cl. 229-16.) A double-walled shipping container is provided with a compartment which is designed to receive a solid refrigerant.

2,572,458. Pressure-sensitive adhesive tape. Warner Eustis, assignor to The Kendall Co., Boston, Mass. Filed May 18, 1944. 5 claims. (Cl. 117-122.) Paper, cellophane, or cloth is coated with a composition having a viscosity from 10^4 to 10^6 poises; the adhesive is a mixture of polybutenes.

2,572,459. Adhesive tape. Warner Eustis, assignor to The Kendall Co., Boston, Mass. Filed March 7, 1951. 5 claims. (Cl. 117-122.)

2,572,610. Carton and carton blank. Jack A. Gilbert, Long Beach, N. Y. Filed June 24, 1949. 4 claims. (Cl. 229-31.) The container is formed with trapezoidal side and end walls so that the filled containers are adequately ventilated when stacked.

2,572,631. Novelty basket. Maurice Kurhan, Brookline, Mass. Filed Sept. 11, 1947. 3 claims. (Cl. 229-8.) A decorative cardboard basket is constructed of three separable interlocking parts.

2,572,655. One-piece paper container. Jesse Norden, Kew Gardens, N. Y. Filed April 19, 1950. 4 claims. (Cl. 229-16.) The carton is constructed with multi-ply vertical beveled edges and a tab for reinforcing the bases of the edges. See U. S. patent 2,468,306.

2,572,686. Automatic closure for valve-bag valves. Per A. S. Andre, Stromsnasbruk, Sweden. Filed Jan. 3, 1946. 10 claims. (Cl. 229-62.5.)

2,572,716. Apparatus for and process of forming single-faced corrugated board. Walter C. George, assignor to Gaylord Container Corp., St. Louis, Mo. Filed June 27, 1940. 8 claims. (Cl. 154-31.) A machine for applying a facing strip to a corrugated board.

2,572,800. Carton setup machine. Le Roy F. Carkhuff, assignor to Shellmar Products Corp., Chicago, Ill. Filed Nov.

23, 1946. 5 claims. (Cl. 93-37.) A machine for setting up egg cartons.

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2,572,924. Hollow plastic product and method of making the same. Desiré Gonda, assignor to Holoplast Ltd., New Hythe, England. Filed July 7, 1948. 5 claims. (Cl. 154-118.) A continuous tube of resin-impregnated paper is the basis of a structural unit.

2,572,929. Method of preparing magnesium bisulfite cooking liquor. Svarre E. Hazelquist, assignor to Weyerhaeuser Timber Co., Tacoma, Wash. Filed March 30, 1950. 2 claims. (Cl. 23-130.) In the preparation of magnesium-base cooking liquor from sulphur dioxide from waste liquor furnace gases, the pH is controlled between 4 and 4.5 by the fortification of the gas with additional sulphur dioxide.

2,572,932. Sizing of pulp with rosin and carboxymethylcellulose. Eleanor F. Horsey and Donna Price, assignors to Hercules Powder Co., Wilmington, Del. Filed May 11, 1946. 1 claim. (Cl. 92-21.) A size is obtained by mixing 75 parts of sodium carboxymethylcellulose with 925 parts of a commercial soda-cooked rosin size containing about 70% by weight of total solids and 20% by weight of free rosin.

2,572,980. Sheet stacking device. William J. Bradford and Otto Wahl, assignors to W. J. Bradford Paper Co., Chicago, Ill. Filed March 10, 1948. 9 claims. (Cl. 271-68.)

2,573,024. Method and apparatus for diluting rosin size. Edgar A. Howell, assignor to American Cyanamid Co., New York, N. Y. Filed Jan. 31, 1941. 3 claims. (Cl. 137-165.) A method of diluting rosin size with hot water and then with cold water.

2,573,049. Preparation of metal-organic compounds. Harold M. Olson, assignor to The Harshaw Chemical Co., Elyria, Ohio. Filed Aug. 31, 1950. 7 claims. (Cl. 260-97.5.) Salts of tall oil are obtained by heating with a metal with an organic solvent. The preparation of a manganese salt is described.

2,573,230. Bag valve. Michael J. Strauss, Cleveland, Ohio. Filed June 11, 1948. 4 claims. (Cl. 229-62.5.) A valve for a gusseted paper valve bag is designed to remain tight after a filling nozzle has been withdrawn from the loaded bag.

2,573,259. Insulated container for bottles. Melvin Goldwater, New York, N. Y. Filed Aug. 28, 1948. 1 claim. (Cl. 229-14.) An insulated container for a nursing bottle.

2,573,321. Defibering apparatus. Alfred F. Ernst, assignor to Certain-teed Products Corp., Chicago, Ill. Filed Jan. 19, 1946. 1 claim. (Cl. 92-7.) An apparatus for defibering wood chips in the presence of steam, using a Venturi tube.

2,573,322. Defibering apparatus. Alfred F. Ernst, assignor to Certain-teed Products Corp., Chicago, Ill. Filed Jan. 19, 1946. 1 claim. (Cl. 92-7.) This is similar to the previous patent, except that an orifice plate is used.

2,573,324. Automatic carton feeder. John L. Ferguson, assignor to J. L. Ferguson Co., Joliet, Ill. Filed March 29, 1946. 4 claims. (Cl. 93-53.) The apparatus includes means for squaring out flattened carton blanks and positioning them, with both ends open, on a holding block.

2,573,355. Production of gypsum wallboard. Michael M. Powers and Clarence J. Loechl, assignors to Certain-teed Products Corp., Ardmore, Pa. Filed Feb. 18, 1950. 2 claims. (Cl. 34-148.) A method of drying the board.

2,573,379. Corner locking construction for paperboard containers. Ralph E. Acker, assignor to Container Corp. of America, Chicago, Ill. Filed Nov. 29, 1947. 3 claims. (Cl. 229-35.) The walls of the carton are automatically locked in the desired trihedral relation when in the setup position.

2,573,393. Carton creasing and closing machine. John Bousquet, assignor to Beech-Nut Packaging Co., Canajoharie, N. Y. Filed Jan. 12, 1946. 2 claims. (Cl. 93-36.) Method of folding in the flaps of packages of gum.

2,573,610. Envelope. Joseph A. Russo, Pittsburgh, Pa. Filed Oct. 19, 1949. 5 claims. (Cl. 229-85.) A mailing envelope with a tear string.

2,573,659. Method of making color ornamented asbestos-cement sheets. Edward M. Bollaert, assignor to United States Gypsum Co., Chicago, Ill. Filed July 27, 1946. 1 claim. (Cl. 92-39.) A method of making a two-tone asbestos-cement shingle.

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2,573,706. Shipping case. Jesse R. Grant, Chicago, Ill. Filed June 21, 1946. 6 claims. (Cl. 229-33.) A two-compartment fiberboard shipping case for eggs, fruits, or the like has a cover which is locked onto the case at both ends and in the middle.

2,573,727. Apparatus for distillation of fatty acids, tall oil, and the like. Ralph H. Potts and Roy N. Olson, assignors to Armour and Co., Chicago, Ill. Filed Dec. 15, 1947. 2 claims. (Cl. 202-154.)

2,573,890. Separation of tall oil components. Rogen M. Christenson and Ralph E. Harpt, assignors to Pittsburgh Plate Glass Co., Allegheny County, Pa. Filed Sept. 4, 1948. 13 claims. (Cl. 260-97.6.) The acids in tall oil are partially esterified and the fatty acid esters are extracted with naphtha.

2,573,894. Compositions of matter comprising halogenated organic compounds. Arthur M. Ellenburg, assignor to Monsanto Chemical Co., St. Louis, Mo. Filed Aug. 10, 1949. 16 claims. (Cl. 252-63.5.) An impregnant for capacitor paper or other electrical insulating papers consists of a chlorinated diphenyl and from 0.05–0.1% of an organic tin compound.

2,573,944. Method and apparatus for feeding blanks. Helmer Anderson, assignor to General Mills, Inc., Minneapolis, Minn. Filed Jan. 23, 1948. 16 claims. (Cl. 271-35.) A device for feeding slotted carton blanks from the bottom of a stack in a direction perpendicular to the slots in the blanks.

2,574,027. Treatment of wood waste. Eduard Farber, assignor to Timber Engineering Co., Washington, D. C. Filed Dec. 23, 1948. 12 claims. (Cl. 71-24.) Wood waste (sawdust and the like) and spent sulphite liquor (acidified with phosphoric acid or hydrochloric acid) are heated at 150 to 270 °C.; the product is useful as a soil conditioner.

2,574,126. Attachment for box-covering machines. Martin V. Silby, New York, N. Y. Filed Dec. 5, 1947. 7 claims. (Cl. 93-54.2.) A means for covering a box shell shaped externally like a truncated pyramid and externally like a parallelepiped.

2,574,127. Attachment for box-covering machines. Martin V. Silby, New York, N. Y. Filed Dec. 5, 1947. 4 claims. (Cl. 93-54.2.) Means for covering a box shell shaped like an octagonal prism.

2,574,154. Machine for winding a sheath around a core. Harold C. Noe, assignor to Joseph Dixon Crucible Co., Jersey City, N. J. Filed Oct. 25, 1948. 11 claims. (Cl. 93-81.) A pencil sheath-forming machine.

2,574,193. Chemical recovery and control in the kraft pulp process. Walter L. Savell, assignor to Remington Rand, Inc., New York, N. Y. Filed Dec. 6, 1947. 6 claims. (Cl. 252-183.) A method of evaporating black liquor, treating with salt cake, and destructively distilling and carbonizing the residue; the hydrogen sulphite is absorbed by the causticized liquor.

2,574,246. Collapsible disposable container. William H. Crosby, Oil City, Pa. Filed June 19, 1950. 5 claims. (Cl. 229-22.) A disposable paraffined container.

2,574,264. Color and color difference meter. Richard S. Hunter, assignor to Henry A. Gardner Laboratory, Inc., Bethesda, Md. Filed March 4, 1949. 22 claims. (Cl. 88-14.) A photoelectric tristimulus colorimeter.

2,574,329. Process and apparatus for producing laminated paper tubes. Charles B. Hemming, assignor to United States Plywood Corp., New York, N. Y. Filed Sept. 22, 1945. 12 claims. (Cl. 93-81.) Method for production and curing thin-walled phenolic resin-impregnated, convoluted paper tubing.

2,574,371. Method of making baskets. Guenther C. F. Brandes, Dundee, Ill. Filed Nov. 3, 1948. 8 claims. (Cl. 93-39.1.) Method of forming a frameless paper wicket basket.

2,574,384. Carton with automatic cover locking means. Walter C. George, assignor to Gaylord Container Corp., St. Louis, Mo. Filed Nov. 1, 1948. 8 claims. (Cl. 229-45.) The molded plastic cooperating locking members are secured to the cover and the body of the box.

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2,574,461. Collapsible cellular carton. Hubert V. Bolding, assignor to The Bradley & Gilbert Co., Louisville, Ky. Filed June 24, 1948. 4 claims. (Cl. 229-28.) A one-piece partitioned container.

2,574,526. Antifungus wrapper and method of producing same. George C. Borden, Jr., assignor to Riegel Paper Corp., New York, N. Y. Filed Aug. 16, 1949. 8 claims. (Cl. 167-22.) A bread wrapper has an inner coating of dimethyl dichlorosuccinate and ethylcellulose and an outer coating of wax.

2,574,584. Apparatus for the surface coating of web materials. John I. Nasmith, assignor to Vickers-Armstrongs Ltd., London, England. Filed May 18, 1948. 5 claims. (Cl. 91-50.) A roll-coating machine for applying adhesive material.

2,574,597. Spray-dried dyestuff powders comprising lignin sulfonate. Victor S. Salvin and William J. Hart, assignors to Celanese Corp. of America, New York, N. Y. Filed March 3, 1949. 5 claims. (Cl. 8-39.) A mixture of a dyestuff, a lignosulphonate, and an inorganic salt in water is milled and then dried in contact with air at about 300 °F.

2,574,927. Container. Irene Mastib, Chicago, Ill. Filed Dec. 12, 1947. 1 claim. (Cl. 229-52.) A dispensing container for cube sugar.

2,574,977. Pulp screen. Wilfred F. Mathewson, assignor to Mathewson Machine Works, Inc., Quincy, Mass. Filed Dec. 10, 1948. 3 claims. (Cl. 92-35.) Inlet and discharge grooves are formed in the inner rotating screen member of a pulp screen.

2,575,013. Production of refined tall oil. Torsten Hasselstrom and Michael Stoll, assignors to National Distillers Products Corp., New York, N. Y. Filed Aug. 1, 1947. 4 claims. (Cl. 260-97.7.) Tall oil soap is mixed with sulphuric acid or

sodium acid sulphate and a hydrocarbon solvent (pH below 7) and allowed to stand; the upper layer contains tall oil free of color bodies.

2,575,192. Article pack. Ernest L. Shepard, assignor to The Canal National Bank of Portland and William B. Nulty, trustees, Portland, Me. Filed Feb. 9, 1948. 2 claims. (Cl. 229-2.5.) A hinged molded pulp container for display.

2,575,257. Adhesive laminated paper and box stay tape. James E. Boulware, assignor to American Reinforced Paper Co., Attleboro, Mass. Filed July 26, 1948. 4 claims. (Cl. 154-53.5.) A method of bonding the marginal edges of a fiber-reinforced, adhesive-laminated wrapping or building paper.

2,575,302. Hydraulic log barking machine having support for log-rotating rollers tiltable to laterally discharge the log. Ernest C. Shaw, assignor to Allis-Chalmers Manufacturing Co., Milwaukee, Wis. Filed May 16, 1946. 7 claims. (Cl. 144-208.)

November 20, 1951

2,575,422. Apparatus for pressing bark-removing cables against a pile, pole, or log. Einer A. Laulainen, Longview, Wash. Filed Sept. 24, 1945. 8 claims. (Cl. 144-208.) A cable is provided for bringing a number of converging longitudinal forces to bear upon a given portion of bark on a log.

2,575,544. Method and apparatus for closing and sealing containers. Julius A. Zinn, Jr., Chicago, Ill. Filed Jan. 26, 1949. 7 claims. (Cl. 93-6.) A method of closing and sealing paraffined containers.

2,575,580. Method of packaging. Edgar F. Cadmus, Portland, Ore. Filed Feb. 14, 1949. 14 claims. (Cl. 93-3.) A method of formation of heavy paper bottle carriers from a continuous web.

2,575,654. Bottle carrier. Roger H. Casler, assignor to Roy S. Sanford, Oakville, Conn. Filed Sept. 16, 1946. 8 claims. (Cl. 229-27.) The carrier incorporates partition-forming members which are integral with the compartment side walls and which strengthen and brace the side walls.

2,575,727. Method of coating glassine. Gerrett H. Peters, assignor to Rhinelander Paper Co., Rhinelander, Wis. Filed Nov. 12, 1947. 5 claims. (Cl. 117-76.) The paper is pretreated with a compound such as sodium carbonate, bicarbonate, phosphate, or silicate, or ammonium phosphate and then coated with a vinyl chloride-vinyl acetate copolymer, chlorinated rubber, or cyclorubber.

2,575,784. Shipping container. Martin Baumann, assignor to International Paper Co., New York, N. Y. Filed April 15, 1949. 3 claims. (Cl. 206-46.) A container for bulky but relatively lightweight articles, such as washing machines, storage cabinets, and the like.

2,575,887. Box blank taping machine. Charles D. Nitchie, assignor to Samuel M. Langston Co., Camden, N. J. Filed May 26, 1949. 17 claims. (Cl. 216-25.)

2,575,895. Method of making fibrous products. Gerrit J. Sluiter, Amsterdam, Netherlands. Filed Sept. 22, 1949. 5 claims. (Cl. 260-740.) The product contains 75 to 100 parts of rubber latex, 5 to 25 parts of glue, and 70 to 80 parts of cellulose fibers.

2,575,898. Padding for packings and method of manufacturing the same. Paul Tadinger, assignor to Leopold Ladner, Vienna, Austria. Filed May 24, 1949. 3 claims. (Cl. 154-110.) A method is proposed for forming shock-absorbing cushions from a continuous strip of corrugated board or paper.

2,576,031. Lubricating grease containing soaps of tall oil. Arnold J. Morway and John J. Kolfenbach, assignors to Standard Oil Development Co., Linden, N. J. Filed April 9, 1949. 7 claims. (Cl. 252-33.6.) A lubricating grease consists essentially of 65–93% of a mineral-base lubricating oil, 5–20% of sodium thallate, and 2–10% of sodium furoate.

2,576,036. Yankee drier. Harry M. Ostertag and John H. Masshard, assignors to Scott Paper Co., Chester, Pa. Filed Nov. 30, 1945. 11 claims. (Cl. 257-95.) A Yankee drier is designed for use with high-pressure steam; the outer cast iron shell and an inner steel shell are spaced apart by hollow rims which serve as annular steam chambers.

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2,576,127. Machine for barking logs. Nils G. Leffler, assignor to Svenska Cellulose Aktiebolaget, Stockholm, Sweden. Filed Nov. 6, 1948. 11 claims. (Cl. 144-208.) A reciprocating barking member of a mechanical barker is a flexible element, such as a chain, wire, or the like.

2,576,166. Decorticator. William E. Wright, assignor to Sea Island Mills, Inc., New York, N. Y. Filed May 3, 1947. 11 claims. (Cl. 19-11.) The apparatus incorporates a fiber-cleaning mechanism for cleaning the butt ends of fiber-bearing plants (e.g., ramie).

2,576,179. Collapsible carrier. Mitchel E. Holy, assignor to Container Corp. of America, Chicago, Ill. Filed June 13, 1949. 2 claims. (Cl. 229-28.) The carrier is erected by a simple hand manipulation and held in such position by assembling with the carrier a partition element.

2,576,274. Drying and curing apparatus. Charles B. Albright, assignor to The Orr Felt & Blanket Co., Piqua, Ohio. Filed Oct. 4, 1947. 12 claims. (Cl. 34-48.) In the drying and curing of resin-impregnated felts, radiant heat from gas-fired burners is used to heat the felt; a large volume of air is drawn through the felt to carry the heat uniformly through the material.

2,576,276. Apparatus for making flock covered paper. Orion W. Berglund, assignor to The Commonwealth Engineering Co., of Ohio, Dayton, Ohio. Filed Aug. 2, 1948. 4 claims. (Cl. 91-8.)

2,576,278. Laminated paper product. John N. Bode, Birmingham, Mich. Filed May 10, 1951. 4 claims. (Cl. 154-55.) A flexible composite laminated paper product has a corrugated cushion layer and an outer scuff-resistant layer.

2,576,281. Corrugating machine. Aloysius J. Carr, Knightstown, Ind. Filed June 9, 1950. 10 claims. (Cl. 154-30.) A drive for a pair of corrugating rolls.

2,576,290. Method of applying a modified wrinkle finish to a base. John R. Fisher, Jr., assignor to New Wrinkle, Inc., Dayton, Ohio. Filed Dec. 29, 1949. 1 claim. (Cl. 117-41.) A wrinkle-drying composition contains a phenol-formaldehyde, tung oil, a solvent, and a drier.

2,576,317. Apparatus for producing self-supporting wrinkle film. Harry A. Toulmin, Jr., assignor to New Wrinkle, Inc., Dayton, Ohio. Filed Jan. 14, 1947. 4 claims. (Cl. 18-15.) The apparatus includes means for the automatic control of film thickness.

2,576,320. Method of reconditioning paper surfaces. John Vlad and John R. Fisher, Jr., assignors to The Commonwealth Engineering Co. of Ohio, Dayton, Ohio. Filed May 1, 1946. 1 claim. (Cl. 117-2.) An inhibitor of so-called "ghosts" on blueprints, photostats, and the like is a mixture of 35 parts of glycerol and 65 parts of ethanol.

2,576,322. Bag with vacuum sealed valve closure. Harry F. Waters, New York, N. Y. Filed July 5, 1947. 2 claims. (Cl. 229-62.5.) The bag is formed of an outer paper sheet and an impervious sheet of plastic-coated metal foil.

2,576,386. Inhibitor of scale formation in steam generation. Paul G. Bird, assignor to National Aluminate Corp., Chicago, Ill. Filed Dec. 6, 1948. 5 claims. (Cl. 210-23.) Scale formation in boiler feed water is prevented by the product from the alkaline hydrolysis of sodium lignosulphonate at 200 to 225°C. under superatmospheric pressure for 20 to 120 minutes.

2,576,418. Lignin compounds and method for making same. Jörgen R. Salvesen and Carlyle Harmon, assignors to Marathon Corp., Rothschild, Wis. Filed Dec. 6, 1948. 7 claims. (Cl. 260-124.) Sodium lignosulphonate is heated with alkali under pressure at 200 to 225°C. for 20 to 120 minutes.

2,576,464. Froth flotation of siliceous impurities from cellulose. Arthur Langmeier, assignor to Hercules Powder Co., Wilmington, Del. Filed Aug. 5, 1948. 15 claims. (Cl. 209-166.) Siliceous material from chemical cotton, wood pulp, or straw pulp is removed by froth flotation with a surface-active compound (e.g., dehydroabiethylamine acetate) and a surface-tension depressant (e.g., pine oil or cumene hydroperoxide).

2,576,542. Method of producing sealed bags. Walter A. Schoen, assignor to Milprint, Inc., Milwaukee, Wis. Filed March 22, 1948. 3 claims. (Cl. 93-3.) A unitary, heat-sealed, commodity-receiving bag has an external end pocket.

2,576,594. Means of forming a pouring spout blank. Saul Goldstein, San Francisco, Calif. Filed March 19, 1948. 1 claim. (Cl. 93-58.) A pouring spout for a cardboard milk container.

2,576,595. Dispensing container. Saul Goldstein, San Francisco, Calif. Filed March 18, 1949. 1 claim. (Cl. 229-17.) A cardboard milk container has a rigid fulcrum point across the bottom of a pouring spout.

2,576,614. Control for papermaking machines. Emmons F. Lewellen and Darcy E. Lewellen, Columbus, Ohio. Filed May 19, 1948. 10 claims. (Cl. 92-46.)

2,576,697. Carton lining device. Earl M. Roach, assignor to Arvey Corp., Chicago, Ill. Filed May 17, 1945. 3 claims. (Cl. 93-36.01.) A mandrel-like device is adapted for the expanding and shaping of an initially flat lined bag to permit the liner to enter and conform to the interior surfaces of a rigid container.

2,576,715. Shipping pallet. James A. Farrell, Detroit, Mich. Filed Jan. 31, 1947. 6 claims. (Cl. 248-120.) A pallet designed for the bottom of a carton incorporates board inserts or bracing cells which serve to stiffen and strengthen the carton against heavy loads.

2,576,752. Method of producing vanillin. John H. Fisher and Harry B. Marshall, assignors to The Ontario Paper Co. Ltd., Thorold, Ontario, Canada. Filed Jan. 7, 1949. 11 claims. (Cl. 260-600.) Lignin, spent sulphite liquor, and the like are oxidized by oxygen at a temperature of 120 to 200°C. The partial oxygen pressure is less than 20 p.s.i.

2,576,753. Method of producing vanillin. John H. Fisher and Harry B. Marshall, assignors to The Ontario Paper Co. Ltd., Thorold, Ontario, Canada. Filed Jan. 7, 1949. 4 claims. (Cl. 260-600.) Vanillin and other oxidation products are obtained by subjecting the compounds in the presence of lime as the active alkali at a pH of 12 or greater to the action of free oxygen finely dispersed in a gaseous medium.

2,576,754. Method of producing vanillin. John H. Fisher and Charles A. Sankey, assignors to The Ontario Paper Co. Ltd., Thorold, Ontario, Canada. Filed July 7, 1949. 8 claims. (Cl. 260-600.) A continuous process is described for the production of oxidation products, including vanillin, from lignosulphonic acids.

2,576,843. Heat exchange apparatus. Carl J. Lockman, assignor to Aktiebolaget Rosenblads Patenter, Stockholm, Sweden. Filed April 20, 1948. 4 claims. (Cl. 257-1.) A heat exchanger designed for the transfer of heat from vapors to a scale-forming liquid includes means for the circulation of condensate through the passages which are used intermittently as vapor passages to secure a more even flow of condensate over the passage walls.

2,576,861. Hydraulic barker with multiple nozzle oscillating linkage. Ernest C. Shaw and Melvin L. Jensen, assignors to Allis-Chalmers Manufacturing Co., Milwaukee, Wis. Filed Nov. 18, 1948. 15 claims. (Cl. 144-208.) A hydraulic barker incorporated oscillating water jets which are automatically adjusted to accommodate logs of various sizes.

2,576,864. Molded filter products. John E. Valente, assignor to Paper Patents Co., Neenah, Wis. Filed July 13, 1946. 9 claims. (Cl. 210-204.) An oil-filter element.

December 4, 1951

2,576,912. Rotatable hollow-head debarker mounting flexible bark-removing elements. Johan Åström, assignor to Svenska Cellulosa Aktiebolaget, Stockholm, Sweden. Filed Feb. 26, 1945. 8 claims. (Cl. 144-208.) A mechanical barker has barking chains which are fixed on a rotatable supporting device that has a central opening through which a log can be fed.

2,576,914. Coated papers and methods and compositions for preparing same. Gerald R. Barrett, assignor to Monsanto Chemical Co., St. Louis, Mo. Filed Feb. 28, 1948. 18 claims. (Cl. 117-155.) The coating agent contains a water-soluble ammonium salt of a copolymer of styrene and the reaction product of maleic anhydride and a monohydric alcohol and an unsaturated fatty acid containing 15 to 18 carbon atoms, generally as a salt.

2,576,933. Sealing tape for tubular bag bodies. William J. Geimer and Frank R. Linda, assignors to Bemis Bro. Bag Co., Minneapolis, Minn. Filed May 6, 1946. 1 claim. (Cl. 154-53.5.) The tape consists of a ply of coarsely woven textile material and a kraft paper ply. The kraft paper is coated on each side with a thermoplastic adhesive.

2,576,966. Method of barking logs. Robert D. Pauley and Louis A. McCanna, assignors to Weyerhaeuser Timber Co., Longview, Wash. Filed Aug. 20, 1946. 9 claims. (Cl. 144–309.) A moving pressure area is imposed against the bark layer momentarily to compress and then release the bark progressively in successive localized areas.

2,576,967. Apparatus for removing bark from logs. Robert D. Pauley and Louis A. McCanna, assignors to Weyerhaeuser Timber Co., Longview, Wash. Filed July 12, 1948. 10 claims. (Cl. 144-208.) A smooth-surfaced barking tool of rather small area is pressed resiliently against the bark surface of the log and moved relatively against the bark surface of the log and relatively to the log under controlled pressure to ride over irregularities in the bark.

2,577,007. Playing card container. William Dubilier, New Rochelle, N.Y. Filed June 12, 1947. 1 claim. (Cl. 229-16.) The container is made of laminated, plasticized, or glazed paper.

2,577,109. Folding paper cup. Harold B. Cranshaw, assignor to Burnitol Manufacturing Co., Boston, Mass. Filed July 9, 1949. 3 claims. (Cl. 229-25.) A folding paper cup has a pivoted cover held in place by a rubber band.

2,577,148. Container construction. John E. Page, West Cornwall, Conn., assignor to Gibson Patent Containers, Ltd. Filed May 7, 1946. 9 claims. (Cl. 229-5.7.) A cylindrical container for bulk ice cream.

2,577,198. Chemical compositions and process for the preparation thereof. Willard H. Kirkpatrick, assignor to Visco Products Co., Houston, Tex. Filed Dec. 28, 1948. 8 claims. (Cl. 260-97.5.) A surface-active chemical is formed by reaction of phthalic anhydride with the product from a dehydrated acylated triethanolamine and tall oil.

2,577,248. Locking means for boxes. Louise James, assignor to Huye Space Saving Box System, Inc., New Orleans, La. Filed June 16, 1947. 4 claims. (Cl. 229-45.) A method of increasing the strength of the locking means.

2,577,304. Container. Lewis C. Brooks, assignor of one third to Ira M. Jones, Milwaukee, Wis. Filed April 11, 1946. 9 claims. (Cl. 229-17.) A double-wall container is provided with shoulders or ledges at its opposite ends for the support of end closures.

2,577,305. Consumer type container. Lewis C. Brooks, assignor of one third to Ira M. Jones, Milwaukee, Wis. Filed March 23, 1949. 12 claims. (Cl. 229–37.) A paperboard milk container.

2,577,418. Tall oil-melamine reaction product and process. Philip C. Hamm, assignor to Monsanto Chemical Co., St. Louis, Mo. Filed Nov. 15, 1949. 2 claims. (Cl. 260-97.5.) Tall oil anhydride (prepared from tall oil and acetic anhydride) and melamine are heated at 160 to 230°C. The product is a water repellent for wood products.

2,577,470. Process for the separation of conidendrin from liquors containing the same. Homer B. Lackey, assignor to Crown Zellerbach Corp., Camas, Wash. Filed April 18, 1949. 14 claims. (Cl. 260-344.6.) Conidendrin is extracted from spent sulphite liquor by trichloroethylene.

2,577,588. Double-walled collapsible carton. Richard E. Paige, New York, N. Y. Filed Nov. 29, 1946. 26 claims. (Cl. 229-14.) The container has a double-wall bottom formed by a series of foldable, automatically interlocking toggle strips.

2,577,529. Carton handling machine. Charles E. Kerr, San Jose, Calif., and Roscoe Elsheimer, Hoopeston, Ill., assignors to Food Machinery and Chemical Corp. Filed July 8, 1946. 17 claims. (Cl. 53-29.) A machine for advancing collapsed one-piece cartons in a continuous flow past an opening, filling, closing, and discharge station.

2,577,624. Mineral-coated paper and process of producing same. George E. Niles, assignor to Monsanto Chemical Co., St. Louis, Mo. Filed March 29, 1947. 7 claims. (Cl. 117-155.) Paper is coated on one side with a color containing 67% water and 33% solids (mineral pigment and 10% of a water-soluble ammonium salt of a styrene-maleic anhydride copolymer).

2,577,709. Coating composition comprising the reaction product of vinyl esters of tall oil acids with styrene and an isopropenyl compound, and the method of preparation. Paul E. Marling, assignor to Monsanto Chemical Co., St. Louis, Mo. Filed Sept. 29, 1948. 10 claims. (Cl. 260-27.) The composition is formed by adding to a heated vinyl ester of tall oil a mixture of styrene and an isopropenylbenzene.

2,577,712. Apparatus for controlling freeness of papermaking stock. Clifton N. Nilson, assignor to Cheney Bigelow Wire Works, Springfield, Mass. Filed May 17, 1947. 3 claims. (Cl. 92-46.)

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2,577,765. Packaging beverage infusor units having string handles and tags. Hans O. Irmscher, assignor to National Urn Bag Co., Inc., Long Island City, N. Y. Filed June 26, 1948. 9 claims. (Cl. 99-171.) Method of packaging tea balls.

2,577,767. Stable, water-soluble, cationic melamine formaldehyde resins. George F. Jones, assignor to Imperial Paper and Color Corp., Glens Falls, N. Y. Filed March 9, 1950. 13 claims. (Cl. 260-67.6.) The cationic properties are produced by the introduction into the resin molecule of an amino alcohol, followed by acidification to a pH of from 0.5 to 2. Stability is obtained by excess formaldehyde, glycerol, or triethanolamine or the like.

2,577,821. Article with water-sensitive gum coating and method of manufacture. Robert L. Smith and Marshall A. Wright, Jr., assignors to Nashua Gummed and Coated Paper Co., Nashua, N. H. Filed March 4, 1947. 5 claims. (Cl. 117-122.) A bone glue or other adhesive is emulsified with xylene or other hydrocarbon in water, coated on kraft paper, and dried. In one example alkali lignin is used.

2,577,863. Paper dust collecting bag for vacuum cleaners. Michael Sosnowich, Brooklyn, N. Y. Filed Sept. 29, 1949 3 claims. (Cl. 183-51.)

2,587,001. Asphalt-base laminating adhesive. Richard H. Cubberley, Lyman P. Hill, and Wilfred J. Mohr, assignors to The Patent and Licensing Corp., New York, N. Y. Filed Dec. 11, 1951. 3 claims. (Cl. 260-732.) A hot-melt laminating adhesive contains 13 to 25 parts of reclaimed rubber or butyl rubber, 13 to 25 parts of rosin or a derivative, and 50 to 74 parts of an asphalt.

2,578,060. Egg case. Jesse R. Grant, Chicago, Ill. Filed Feb. 21, 1946. 9 claims. (Cl. 229-15.) The egg case has a central partition that is securely fastened to the side walls and bottom of the case. The cover locks at both ends and in the middle and can be completely removed from the case.

2,578,064. Contractile reel for paper cutting machines. John M. Hammond, assignor to Herman J. Minkus, Los Angeles, Calif. Filed Jan. 5, 1948. 3 claims. (Cl. 242-72.) Means for cutting paper into sheets of predetermined uniform lengths.

2,578,107. Shipping package for storage batteries. Bernard J. Thacker, Scott C. Harris, and Walter O. Newstrom, assignors to I. Henry Harris, Jr., Glendale, Calif. Filed April 26, 1949. 3 claims. (Cl. 229-14.) The blank includes additional tabs

which can be rolled up to form a spacer or terminal protectors integral with the remainder of the containers.

2,578,150. Decalcomania and method of applying same. Harry C. Rathke, assignor to The Meyercord Co., Chicago, Ill. Filed Dec. 12, 1947. 10 claims. (Cl. 154-98.) A decalcomania is described which can be applied to dressed poultry.

2,578,174. Cellular container. Walton B. Crane, assignor to Alpak, Los Angeles, Calif. Filed April 1, 1949. 7 claims. (Cl. 229-28.) A bottle carrier and its construction.

2,578,244. Paper container. John K. M. Harrison, Gainesville, Va. Filed June 24, 1947. 1 claim. (Cl. 229–5.5.) A container for liquids such as oils or foodstuffs has a closure in which is a removable plug.

2,578,297. Machine for packaging merchandise rolls. Carl J. Gerlach, Green Bay, Wis. Filed Nov. 3, 1947. 7 claims. (Cl. 53-115.) A machine for wrapping paper rolls and a method for tucking and forming the ends of the package; means are provided for applying labels to the packages.

2,578,345. Method for imprinting coatings on paper and paperboard. Harry C. Fisher and Brainard E. Sooy, assignors to Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis. Filed Nov. 23, 1946. 6 claims. (Cl. 117–60.) The sheet is treated with a 3% aqueous solution of converted starch and then with a mineral coating (clay and titanium dioxide).

2,578,461. Winding machine. Carl O. Bachman, Watertown, N. Y. Filed March 8, 1949. 12 claims. (Cl. 242–66.)

2,578,489. Artificial wood product and method of making the same. Charles Roman, Miami, Fla. Filed Dec. 9, 1946. 12 claims. (Cl. 260-17.2.) A synthetic board is formed from bagasse and a urea-formaldehyde resin.

2,578,551. Suction roll seal assembly. Lloyd Hornbostel, assignor to Beloit Iron Works, Beloit, Wis. Filed March 5, 1948. 5 claims. (Cl. 92-53.) A sealing strip for a suction gland and a mounting therefor includes an expansible tube for pressing the strip against the suction roll and means for supplying water to lubricate the sides of the strip.

2,578,552. Drier section for paper machines. Lloyd Hornbostel, assignor to Beloit Iron Works, Beloit, Wis. Filed Oct. 6, 1948. 10 claims. (Cl. 34-121.) A flexible expansion joint is interposed between separated individual gear cases of the bottom row of drier drums; each gear case is securely bolted to the sole plate of the machine for fixed positioning of the bearing supports.

2,578,580. Reinforcing asbestos-cement sheets and apparatus for use therein. Frank L. Nash, assignor to Turners Asbestos Cement Co. Ltd., Rochdale, England. Filed Aug. 18, 1948. 3 claims. (Cl. 92-67.) An apparatus and means for forming wire-reinforced sheets of asbestos and cement.

2,578,581. Reinforcing asbestos-cement sheets. Frank L. Nash, assignor to Turners Asbestos Cement Co., Ltd., Rochdale, England. Filed June 22, 1950. 4 claims. (Cl. 92-55.) A method for the formation of wire-reinforced sheets of asbestos and cement.

2,578,594. Calender machine. Charles P. Putnam, assignor to New York and Pennsylvania Co., Inc., New York, N.Y. Filed Dec. 20, 1948. 5 claims. (Cl. 92-75.) A tandem-type supercalender includes swingably mounted, resilient, soft fiber rolls which can be replaced without stopping or slowing down the machine.

2,578,598. Apparatus for reinforcing asbestos-cement sheets. William H. Rooksby, assignor to Turners Asbestos Cement Co. Ltd., Rochdale, England. Filed June 1, 1946. 10 claims. (Cl. 92-66.) Means are provided for the introduction of reinforcing wires onto a forming roll without stoppage or speed reduction of the roll.

2,578,625. Glossmeter. Kenneth Bowers and Thomas E. Mason, assignors to Glens Falls Laboratory, Inc., Glens Falls, N. Y. Filed July 3, 1948. 2 claims. (Cl. 88-14.) A glossmeter is adapted to the continuous measurement of the gloss of a paper web immediately after it leaves a calender stack and before it passes to the winder.

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2,578,661. Cyclic reuse of cyclohexylamine in rosin acids separation. Vigen K. Babayan, assignor to The Fulwal Chemical Corp., New York, N. Y. Filed Sept. 1, 1949. 5 claims. (Cl. 260-97.6.) A method of isolating rosin acids from tall oil by the use of cyclohexylamine.

2,578,731. Container and assembling machine. Ronald E. J. Nordquist and Herbert F. Cox, Jr., assignors to American Can Co., New York, N. Y. Filed March 12, 1946. 3 claims. (Cl. 93–55.1.) This is an improvement on U. S. patent 2,265,188 (Dec. 9, 1941) and has particular reference to curling over a flange part of a fiber container body to hold an end member in place in the body.

2,578,739. Molded carton for fragile articles. Walter H. Randall, assignor to The Canal National Bank of Portland and William B. Nutley, Portland, Me., as trustees. Filed Dec. 24, 1947. 3 claims. (Cl. 229-2.5.) This patent covers particularly cartons of molded pulp for packaging eggs.

2,578,774. Heavy-duty fiber container. Samuel P. Belsinger, assignor to Belsinger, Inc., Atlanta, Ga. Filed Aug. 10, 1948. 1 claim. (Cl. 229-27.) This covers a heavy-duty container for crating eggs, oranges, and the like.

2,578,775. Heavy-duty fiber container. Samuel P. Belsinger, assignor to Belsinger, Inc., Atlanta, Ga. Filed June 17, 1949. 1 claim. (Cl. 229-27.) A carton for packing citrus fruits has reinforced bottom and side walls and has a supporting means for the ends of the inner cover member.

2,578,776. Heavy-duty fiber container. Samuel P. Belsinger, assignor to Belsinger, Inc., Atlanta, Ga. Filed March 1, 1950. 3 claims. (Cl. 229–27.) The container when assembled is provided with partition members extending through a slot in the rear walls; these are firmly connected to the front wall by flaps extending through a slot therein.

2,578,777. Heavy-duty fiber container. Samuel P. Belsinger, assignor to Belsinger, Inc., Atlanta, Ga. Filed March 1, 1950. 3 claims. (Cl. 229-27.) The container when assembled is provided with double side walls, double end walls, and a double bottom.

2,578,804. Hydraulic-type log debarker having centripetally directed jets mounted in circumferential groups radially adjustable for different size logs. Joseph E. Holveck and Arthur G. Rockwood, assignors to Worthington Pump and Machinery Corp., Harrison, N. J. Filed April 30, 1946. 36 claims. (Cl. 144-208.)

2,578,878. Tray type carton. Kenneth T. Buttery, assignor to Sutherland Paper Co., Kalamazoo, Mich. Filed July 15, 1947. 5 claims. (Cl. 229-35.) The container when erected has walls which are interlocked and supported to sustain substantial loads; the side and end walls are supported substantially at right angles to the bottom.

2,578,883. Pitchy composition and a method of making it. Otto F. V. Frick, Stockholm, Sweden. Filed April 29, 1948. 14 claims. (Cl. 106-123.) The noncracked pitchy residue from the vacuum steam distillation of tall oil is treated with aluminum hydroxide and the precipitated aluminum salt is mixed with a filler, such as asbestos, to give a material for roofing or flooring or for insulating purposes.

2,578,955. Composition of tall oil and aromatic oil and method of making it. Edward A. Van Valkenburgh, Greene, N. Y. Filed Oct. 14, 1950. 7 claims. (Cl. 106-123.) A composition for compounding with GR-S synthetic rubber and mixtures with natural rubber consists of heat-treated tall oil preheated to a temperature in excess of 260 °F. and a coal tar oil or a petroleum aromatic oil.

2,579,226. Stock regulator. Hervey G. Cram, assignor to Combined Locks Paper Co., Combined Locks, Wis. Filed Aug. 26, 1948. 8 claims. (Cl. 137-78.) A mechanical arrangement which will deliver a predetermined rate of volume flow of stock to the machine by means of a gate arrangement.

2,579,346. Self-locking box. Per O. Theander, Goteborg, Sweden. Filed April 29, 1948. 2 claims. (Cl. 229-45.) The walls of the box are provided with a number of slots parallel to the bottom portion and in which the side walls of the cover are provided with slots by means of which the receptacle can be locked.

2,579,391. In-place resurfacing of ponderous cylinders. Rudolf G. Minarik and Eric N. Isakson, assignors to Paper Patents Co., Neenah, Wis. Filed June 13, 1946. 1 claim. (Cl. 51-251.) Apparatus for grinding the surface of a heavy cylinder, such as the drying cylinders of Yankee paper machines.

December 25, 1951

2,579,481. Adhesive composition. James E. Fenn, Baldwin, N. Y., assignor of one tenth to Charles H. Brown, Princeton, N. J. Filed Dec. 25, 1951. 11 claims. (Cl. 260-17.5.) Concentrated spent sulphite liquor (lignone) (500 pounds—250 pounds solids) and 2.5 pounds of solid phosphoric acid are heated to 185 °F., cooled to 90 °F., treated with 70.1 pounds of urea or thiourea and then with 234 pounds of polyvinyl alcohol solution (28.1 pounds solids) and stirred until homogeneous. The product is a remoistenable adhesive.

2,579,482. Adhesive composition of sulphite waste liquor, phosphoric acid, and sulphur dioxide. James E. Fenn, Baldwin, N. Y., assignor of one tenth to Charles H. Brown, Princeton, N. J. Filed Feb. 17, 1948. 10 claims. (Cl. 260-17.5.) A remoistenable adhesive consists of lignone and about 1% phosphoric acid which is heated to 175–195 °F. and treated with sulphur dioxide (equivalent to that released by 1% zinc hydrosulphite).

2,579,483. Adhesive composition. James E. Fenn, Baldwin, N. Y., assignor of one tenth to Charles H. Brown, Princeton, N. J. Filed July 29, 1949. 9 claims. (Cl. 260-17.5.) An adhesive consists of lignone, 2–25% polyvinyl alcohol, 10–20% of a plasticizer (urea or thiourea), and 2–6% of formamide, with about 0.65% of zinc hydrosulphite.

2,579,490. Face powder box. Rosalie A. Gordon, Indianapo-

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lis, Ind. Filed June 15, 1948. 1 claim. (Cl. 229-51.) The box includes means for forming dispensing openings of progressively increased size in the cover.

2,579,518. Container. Edward G. Schaefer, Newark, N. J. Filed Dec. 21, 1946. 5 claims. (Cl. 229-32.) A one- or two-piece container in which the top and bottom may be identical, with an open side for examination of the contents, and a simple closure.

2,579,613. Hydraulic log barking apparatus. William H. Rambo and Harold A. DeRice, Portland, Ore. Filed July 28, 1947. 6 claims. (Cl. 299-66.) Means for directing a jet or spray against the surface of a log while producing such relative movement of the log and the jet or spray as to completely traverse the entire surface of the log.

2,579,758. Dispensing and disposing tissue container. Abraham W. Rosenman, Fairfield, and Rudolph F. Greiser, Easton, Conn. Filed Feb. 12, 1949. 1 claim. (Cl. 206-57.) Containers suitable for the dispensing and disposing of tissues and/or absorbent sheets.

2,579,760. Folding carton. William R. Saidel, Green Bay, Wis. Filed March 18, 1949. 5 claims. (Cl. 229-27.) A carton in which parts of the top are turned downwardly into perpendicular positions to form the ends and transverse partitions that divide the carton into side-by-side commodity-receiving compartments.

2,579,770. Fiber dispersing machine and method. Curt Uschmann, assignor to Cascades Plywood Corp., Portland, Ore. Filed July 30, 1947. 14 claims. (Cl. 154-1.) A method of manufacturing synthetic lumber.

2,579,802. Fiber case gluing machine. Edward J. Derderian, assignor to Elliott Manufacturing Co., Fresno, Calif. Filed May 15, 1945. 3 claims. (Cl. 93-36.4.) A machine for applying an adhesive to the outer surfaces of the inner flaps of a fiber case.

2,579,803. Case sealing machine. Edward J. Derderian, assignor to Elliott Manufacturing Co., Fresno, Calif. Filed Dec. 15, 1947. 4 claims. (Cl. 53-145.) A machine which seals the top and bottom flaps of a fiber case after the case has been loaded.

2,579,880. Package. Tryggve B. Stue, Oslo, Norway. Filed Sept. 15, 1947. 4 claims. (Cl. 229-9.) A cigarette package.

2,579,907. Paper container lining machine. Robert S. Condon, assignor to Continental Can Co., Inc., New York, N. Y. Filed April 25, 1949. 20 claims. (Cl. 93-36.01.) A machine for forming and shaping corrugated liners from a continuous strip of liner material and inserting the liners into containers.

2,579,949. Laminated product and method of laminating. Festus L. Minnear, assignor to Continental Can Co., Inc., New York, N. Y. Filed June 18, 1947. 3 claims. (Cl. 154-128.) Paper and woven glass fiber cloth are impregnated with a resin and laminated to give a wall tile or table mat.

2,579,974. Container end structure. Harry A. Scott and John W. Spieker, assignors to Continental Can Co., New York, N. Y. Filed Oct. 29, 1947. 1 claim. (Cl. 229-47.) The clamping ring of a container end structure is so designed that, when it is contracted into position on the end of the container, it presents a flat, vertically disposed outer surface.

2,580,043. Combination carton and wrapper for fragile articles. Richard E. Paige, New York, N. Y. Filed Jan. 12, 1946. 5 claims. (Cl. 208-65.) A method of forming a container for a stem-type drinking glass and the like.

2,580,161. Process of deinking printed waste paper. Cornelius C. Driessen, Little Chute, Wis. Filed March 13, 1947. 1 claim. (Cl. 92-1.5.) The deinking solution contains 2% alkali, 4% soap, 6.5% caustic soda, and 5% chlorine; the pH of the solution is from 8.5 to 10.5.

2,580,180. Method of folding cartons. Reginald B. Meller, Oakland, Calif., assignor to Bemiss-Jason Co. Filed June 23, 1947. 2 claims. (Cl. 93-49.) A method of interlocking panels of a folding box without the use of adhesives, staples, or rivets.

2,580,181. Self-locking folding box. Reginald B. Meller, Oakland, Calif., assignor to Bemiss-Jason Co. Filed Dec. 4, 1947. 4 claims. (Cl. 229-35.) A form of interlock which is aided by but is not dependent on the resiliency of the board for maintaining the interlock intact.

2,580,189. Carton folder. Edward J. Pagendarm, San Mateo, Calif., assignor to Bemiss-Jason Co. Filed April 7, 1947. 9 claims. (Cl. 93-51.) A method for making boxes which are maintained in set-up condition by a glueless interlock of cut edges.

2,580,286. Process of treating cellulosic and similar materials. Rowell R. Dorsett, Baltimore, Md. Filed Dec. 4, 1946. 3 claims. (Cl. 117-138.4.) Textiles, papers, and the like are protected against the action of acids by treatment with an aqueous solution of a dehydrated phosphate.

2,580,333. Divisible carton. Allen B. Thomas, Rochester, N. Y. Filed May 28, 1949. 4 claims. (Cl. 229-15.) Container for bottled beer and the like.

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Calendar of TAPPI Meetings

NATIONAL

Annual Meeting, Commodore Hotel, New York, N. Y., February 18–21, 1952

Third Coating Conference, Sherman Hotel, Chicago, Ill., May 5–8, 1952.

Seventh Engineering Conference, Morrison Hotel, Chicago, Ill., October 13–16, 1952.

LOCAL SECTIONS

LAKE ERIE SECTION:
March 21, 1952, Hickory Grill, Cleveland, Ohio

DELAWARE VALLEY SECTION:
March 27, 1952, Engineer's Club, Philadelphia, Pa.

OHIO SECTION:
March 13, 1952, Manchester Hotel, Middletown, Ohio

NEW ENGLAND SECTION:
April 20, 1952, Fitchburg, Mass.

PACIFIC SECTION:
March 21, 1952, Camas, Wash.

EMPIRE STATE SECTION:
(Western District) April 3, 1952, Niagara Falls, N. Y.
(Eastern District) March 20, 1952, So. Glens Falls, N. Y.
(Central District) March 7, 1952, Syracuse, N. Y.
(Northern District) March 13, 1952, Watertown, N. Y.
(Metropolitan District) March 11, 1952, New York City
Annual Meeting, June 18–21, 1952. General Brock Hotel, Niagara Falls, Ont.

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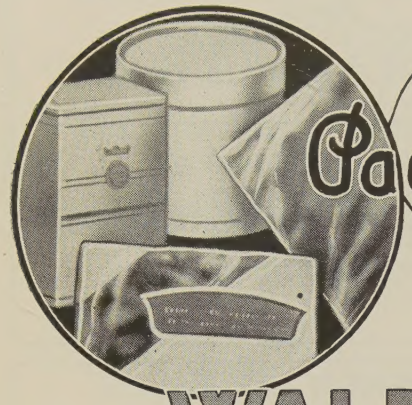

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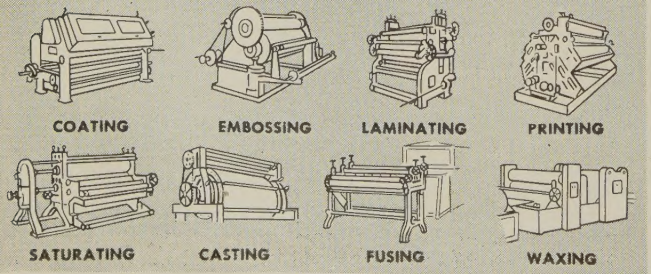

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